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CONTENTS

	Page
The Atlantic Charter and its Agricultural Implications	57
African Geomorphology. By Dr. P. E. Kent	59
Population and Emigration. By Prof. H. J. Fleure, F.R.S.	60
American Army Naturalists	61
The Vertebrate Retina. By Dr. Katharine Tansley	61
Langstroth, the Apiarist. By Dr. H. M. Fraser	62
Science in Chungking. By Dr. Joseph Needham, F.R.S.	64
Non-Solar Planets. By Dr. A. Hunter	66
United Nations Conference on Food and Agriculture	67
Obituary:	
Prof. Antonín Šimek. By Dr. G. Druce	69
British and Russian Men of Science: Exchange of Greetings	70
News and Views	71
Letters to the Editors:	
Factorial Analysis of Physical Growth.—Prof. Cyril Burt	75
Semi-conducting Properties of Stannous Sulphide.—Merial C. Clark and J. S. Anderson	75
Reaction between Long-Chain Cation-active Salts and Sodium Hexametaphosphate.—Dr. J. Powney	76
The Donnan Membrane Equilibrium.—S. G. Chaudhury	76
Relation of Tea 'Fermentation' to Normal Respiration.—E. A. Houghton Roberts	77
Ascorbic Acid Content of Recently Harvested Cereals and Legumes.—M. N. Rudra	78
High-angle Edge-flaking of Flint.—J. Reid Moir, F.R.S.	78
A Nuclear Ring in the Developing Male Germ Cells of the Dog and Cat.—Prof. J. Brontë Gatenby	79
Science, Christianity and Truth.—Dr. Julian S. Huxley, F.R.S.	79
Future of Technical Colleges.—R. M. Barrer and J. P. Andrews	80
Microchemical Apparatus.—Stanley J. Davies	80
Magnesium-Calcium Antagonism in Muscle. By Dr. G. D. Greville and Dr. H. Lehmann	81
Recent Advances in Immunochemistry. By Dr. W. T. J. Morgan	82
Radio Research on Metre Waves	83

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THE ATLANTIC CHARTER AND ITS AGRICULTURAL IMPLICATIONS

WHEN the Atlantic Charter was announced, it was widely acclaimed as embodying the great ideals at which administrators all over the world should aim. There was indeed no novelty in the ideals themselves; they had been put forward many times before. The new feature was their acceptance by politicians as not only desirable but also practicable, and therefore to be incorporated in their political programmes. The first step was to call a conference of representatives of the Allied Nations to discuss appropriate action, and this was done by the United States Government. The conference met at Hot Springs, Virginia, during May 18–June 3, 1943; no less than forty-four countries participated. In order to keep the discussion within bounds and to ensure so far as possible a practical outcome, the Conference restricted itself to the consideration of "the goal of freedom from want in relation to food and agriculture", to quote its own words; "freedom from want," it stated, "means a secure, adequate, and suitable supply of food for every man". The results of the deliberations have recently been published as a White Paper.

The numerous technical points that arose are dealt with elsewhere (p. 68); it is proposed here to discuss some of the broader issues. The basic recommendation sounds self-evident but actually involves the most far-reaching consequences; it was that "the Governments and authorities represented should declare to their own people and to one another their intention to secure more and better food for the people", and this was embodied in a resolution which epitomizes the whole of the deliberations of the Conference; each Government bound itself to provide for its own people the highest standard of nutrition which it could achieve, and each undertook to collaborate with the others "so that levels of food consumption may become more equitable, not only among the different sections of the population in a given country but among the several nations of the world as well". It was recognized that food policy and agricultural policy are inseparably intertwined, and during the discussions it became evident that the types of food most generally required to improve the peoples' diets and health are in many cases those produced by methods of farming best calculated to maintain the productivity of the soil and to increase and make more stable the returns to agricultural producers. Better nutrition, in short, means better farming. Seeing that more than two thirds of the human population are producers of food, any improvement in their position must be for the advantage of mankind as a whole.

Next it was shown that there is a close interdependence between the level of employment in the different countries and the standards of nutrition. But the level of employment in turn depends on the character and extent of the industrial development, the management of currencies, the direction of national and international investment, and the

policy adopted towards foreign trade. While it could not investigate the methods needed to promote expansion of economic activity, the Conference declared that freedom from want could not be fully attained without this expansion, and recommended that the various Governments and authorities should take action, individually and collectively, to achieve it.

So large a proportion of the human race has hitherto been underfed that higher nutrition for all people even in Europe would necessitate a greatly increased output of food, and if Africa and Asia were included an enormous increase would be required. But the Conference remained undaunted and was convinced that the necessary supplies could be produced. Machinery, however, would have to be set up for dealing with the gluts of food periodically accumulating in bounteous seasons, which have hitherto proved very detrimental to farmers and consumers alike, and of advantage only to certain financial operators. To deal with this it was proposed that 'buffer stocks' should be set up to absorb the excesses of good years and deal them out to places where more food is needed. Finally, it was agreed that matters should not be allowed to rest with the mere publication of these resolutions; a permanent organization should be set up to help in carrying them out, and the task of establishing this body and of attaining the other objectives set forth in the resolutions was assigned to an interim commission composed of one representative of each country, which should meet not later than July 15, 1943. The United States Government accepted the responsibility for calling together this body.

If these proposals are acted upon by the participating nations, a profound change will be produced not only in agriculture but also in world politics. Hitherto three different policies have been adopted in regard to food production. During the *laisser-faire* period of the nineteenth century, the purpose was to give the greatest amount of profit to the individual, but to leave things entirely in his hands, the Government neither deliberately helping nor deliberately hindering him. It was expected that each country would produce the commodities it could most easily and cheaply supply, and the different countries would then exchange their surpluses. This led to specialization, which had many advantages; but in the end the resulting 'mono-culture', as it became termed, proved fatal to the soil; it led to the 'dust bowl' of western North America, and to soil deterioration and soil erosion in many other countries; according to the *laisser-faire* policy, the present owner of the land was entitled to ruin it if it suited him, and no responsibility to the future need be entertained. Quite apart from the bad ethics, there was much bad economics in the system, for when the market requirements changed or a cheaper producer appeared, the cultivators might be ruined before they could find new products and effect the necessary changes in their agriculture, which is always a slow business. This policy has therefore been given up.

Another policy widely adopted was self-sufficiency. Each country should produce all the necessary food that it can, and it should learn to go without those products that could be obtained only from overseas. This policy was closely linked up with preparation for war, either aggressive or defensive. A nation dependent on imports of food, it was argued, would be in a weak position when war broke out, and indeed the issue might be decided by simply cutting off its imports. This policy was enthusiastically adopted by Germany and Italy before the War, and more or less reluctantly by some of the adjacent countries, which felt they had no option but to prepare for contingencies.

The third policy is that of optimum nutrition, which the Conference adopted. Strictly speaking, it has never been tried in all its fullness, but some countries came near to it, notably the United Kingdom, the Dominions, the United States, Denmark, Holland, Belgium and Switzerland. For these, comparatively small changes in the type of agriculture would be needed if the high nutrition policy were generally adopted in practice.

The Conference decisions have come as no surprise to agriculturists. A high nutrition policy was proposed at Geneva in 1934 by Bruce and McDougal of Australia, and its implications worked out by Orr and others; an unofficial group of agriculturists organized by Lord Astor examined its agricultural consequences for Great Britain. It was considered, and to a greater or less extent embodied, in each of the proposals for the reorganization of British agriculture put forward by the various important responsible bodies and by many smaller less-known groups of people. The high nutrition policy necessitates some degree of planning in agricultural production and this means some degree of control; all the responsible bodies are prepared to accept this. It means also something in the nature of a national contract between farmers on one side and consumers on the other, which, of course, implies agreed prices having relation to the costs of production, and provisions to ensure delivery of the commodities in the agreed quantities and of approved quality; in other words, power to enforce efficient farming. This also is commonly accepted. The differences between the various sets of proposals are in detail only.

The Royal Agricultural Society, the most widely representative body of all, recommends that a non-political statutory body, a Food Commission somewhat on the lines of the Forestry Commission, should be set up in Great Britain to ensure adequate food production, the maintenance of soil fertility, and a price-level sufficient to yield a reasonable profit on average land after payment of adequate wages. The Government should decide the proportion of the different foodstuffs to be produced at home and it should maintain the price-level by imposing import duties, not by direct subsidies. Steps would need to be taken for raising the efficiency of farming; there must be better production, better marketing and distribution, more research, more effort to apply the results of science, and more, and more suitable, education. The National Farmers Union, which includes a large proportion of the farmers of Great Britain, proposes the setting up of a Food Ministry which would regulate supplies and prices,

but as a safety measure there should be maintained in England and Wales a minimum of 11 million acres of tillage land (that is, arable land, *less leys*) including 2¼ million acres of wheat, 600,000 acres of potatoes, 400,000 acres of sugar beet and 800,000 acres of fruit and vegetables; for the ten years prior to the War the actual average figures were: tillage land, 7·1 million acres; wheat, 1·6 million; potatoes, 475,000; sugar beet, 318,000. Price control of wheat and meat should be effected by organizing marketing and imports on the lines recommended by the Sydney Conference of 1938.

The proposals of the Conservative Party also necessitate price stability and satisfactory price-level, effected by controlling the imports of food by an Import Board and a levy subsidy, even in some cases a high tariff. Direct subsidies are to be avoided. Measures for increasing the population and improving the level of nutrition would be welcomed within limits, though a nutrition policy would not obviate the need for general price stability.

The recent memorandum issued by a "Group of Peers holding varying Political Creeds" boldly adopts the nutrition policy, and urges that in our dealings with other countries we should press them also to adopt it. Tariffs afford no solution to the price problem, nor do direct subsidies. They divide agricultural produce into two groups: commodities, the production of which is incidental to good husbandry, such as wheat (oats in Scotland), sugar beet, and meat; and those needed for high nutrition, such as milk, poultry products, fruit and vegetables. For the former it would be essential to set up import quotas at prices agreed beforehand. For wheat, as a safety measure, home production should be approximately the 1939 acreage plus 10 per cent; the price paid would be based on the average cost of efficient production, but the consumer would pay less because he would benefit by the lower price of imported wheat. Any gluts would be cleared by selling at specially low prices to nations below the poverty line. The other products would find a ready market if a nutrition policy were adopted by the nation; at present we do not produce nearly enough of them. For milk, eggs, fruit and vegetables, an increase of 60–70 per cent on pre-war figures would be needed, as well as an additional 25 per cent output of meat.

There is much evidence also that the people of the occupied countries of Europe are ready to accept a high nutrition policy. Certainly they have had a bitter enough experience of the self-sufficiency policy. It was carried out more thoroughly and systematically in Germany than anywhere else, and yet there it gave its people much less of the delectable foods than we had in Great Britain; on the average, only one half our beef and our sugar, very little lamb, only about two thirds of our butter and eggs, and much less fruit. To make up for these deficiencies they had double our rations of potatoes. In other countries things were worse, and a high nutrition policy would be a welcome change. Admittedly it involves difficult economic and administrative problems, but it seems to offer the best hope for reconstruction and for permanent peace. It fully deserves a trial.

AFRICAN GEOMORPHOLOGY

South African Scenery

A Textbook of Geomorphology. By Dr. L. C. King. Pp. xxiv+340+144 plates. (Edinburgh and London: Oliver and Boyd, 1942.) 25*s*. net.

A YEAR ago, C. A. Cotton published a text-book of geomorphology in which the account was illustrated primarily from the topography of New Zealand. A similar volume by Dr. L. C. King, taking its examples from South Africa, has now become available. Whereas New Zealand provides unsurpassed examples of land forms developed in a humid climate, South African scenery has developed under conditions of limited rainfall, often approximating to desert. The new book thus covers a range of phenomena different in detail from those described by Cotton, and the two books are in many ways complementary.

The scope of "South African Scenery" is wider than one might expect. "South Africa" is conveniently taken as the part of the continent south of the equator, so that it is possible to include an account of the East African rift valleys, lakes and volcanoes, and thus extend the description of land forms beyond those available in South Africa proper.

The greater part of the book is devoted to description of the development of land forms by the various erosive agencies, and to their modification by earth movement and volcanic action. This is treated on stereotyped lines, but gains greatly in interest from the constant reference to excellent examples, mainly in southern Africa, and from the freshness of the examples chosen. The land forms are linked with the geological history and surface geology throughout, with a resulting great gain in understanding of the development of the scenery.

An account of the disastrous effect of ravine formation and resulting soil erosion, and of the methods of prevention, is of particular interest in view of the growing importance of the subject. The enactment of new legislation by the Government of Kenya has just been announced, for example.

King makes frequent reference to the effects of Pre-Karroo, Cretaceous and Tertiary periods of erosion, and their separation and identification is a feature which helps to make South Africa unique to geomorphologists. One is, however, inclined to feel that some account might also have been given of the dating of South African river terraces and climatic fluctuations by means of human cultures and the contained fauna, now that information of this kind is becoming available. For example, it would have been more illuminating to have stated that the Victoria Falls have retreated five miles up-stream since the Middle Pleistocene, rather than since man first appeared in the region, and a summary of the evidence bearing upon the date of Pleistocene earth movements would be a welcome addition.

One of the more interesting subjects on which King touches is the uplift of the southern and central parts of the African continent. In East Africa this uplift amounted to 3,000–5,000 ft. over vast areas, and there is evidence to show that it has taken place over a period covering most of Tertiary times. It was largely completed by the end of the Pliocene. The associated rifting movements, however, form a complicating factor and hinder full analysis. In South Africa the rifts are absent, but a comparable uplift has nevertheless taken place. Du Toit

(*S. African Geog. J.*, **16**, 3; 1933) has given a detailed account of the history of this uplift, which has raised the "Great Miocene Peneplain" to 4,000–5,000 ft. in the High Veld, and King reproduces much of the most recent information on the subject.

When the Miocene peneplain was formed, the surface of South and East Africa must have been nearly at sea-level, and in isostatic equilibrium for a long period. In East Africa the uplifted peneplain is still in isostatic equilibrium, and fossiliferous Miocene beds remain to prove that the surface has not been lowered appreciably by erosion since the middle Tertiary. In South Africa, du Toit suggested that the uplift was due to "unloading under erosion", but King states that the Miocene peneplain is clearly identifiable in the High Veld, and there is in any event no obvious reason for the adjustment having been so greatly overdone. Thus four thousand feet of vertical uplift has affected a third of a continent, without any important folding or thickening of the crust. What changes in the suberust have produced this remarkable effect?

A general description of the Rift Valleys and the theories of their origin follows the detailed discussion of effects of the more common types of earth movement. Here King disposes of the rather surprising suggestion advanced a few years ago that the rift valleys owe their formation largely to erosion, and goes on to describe the conflicting tectonic theories of their origin. The 1938–40 eruptions of volcanoes of the western rift in the Belgian Congo are illustrated by an excellent series of photographs, which demonstrate vividly the surface features of recent lava flows.

The latter part of the book consists of a description of the topography of Southern Africa on a regional basis. This section deals first with Central and South-Central Africa, describing the geological history of each country in so far as it affects the physical features, and then goes on to describe the surface features of South Africa *sensu stricto* by natural regions. A considerable proportion of the information in this section is derived from work of the last twenty years, and the description is particularly valuable. This part of the book might perhaps have been improved by extension of the natural region treatment to the whole area instead of using political boundaries for Central Africa, which involves division of the description of the western Rift Valley, for example, between Uganda and the Belgian Congo.

The volume has the disadvantage common among books of this kind in that the only references given are suggestions for further study, and no mention is made of the sources of information or authors of hypotheses. These would be especially welcome in view of the recent character of much of the work on which description is based. One regrets, for example, the omission of any reference to Wayland when the results of his work in Uganda are described at some length in the text. Similarly, although Bailey Willis's monograph on East African geomorphology is quoted in the short bibliography, no reference is given to show where his work is reproduced.

"South African Scenery" is excellently produced and written. The richness of illustration may be indicated by the statement that the book has 144 half-tone plates to 340 pages of text. No one will read this volume without realizing that southern Africa is not merely a country of monotonous peneplain but also has areas of extreme grandeur. The book is a really worth-while possession.

P. E. KENT.

POPULATION AND EMIGRATION

The Political Economy of Population

By Prof. Radhakamal Mukerjee. (Lucknow University Studies, Faculty of Arts.) Pp. xiv+467. (London, Bombay, New York and Toronto: Longmans, Green and Co., Ltd., n.d.) 7*s.* 6*d.*

THE author is the personification of energy and versatility as he pours out book after book devoted to the setting forth of the facts, and inferences, of human ecology. For us, in Europe, he has the added value that he knows a great deal about us and writes in our language, a rather American English, while at the same time speaking from the point of view of a member of the huge concentration of half mankind on the relatively small space of the Monsoon Lands. Mukerjee continually reiterates that political economy, biology, genetics, politics and sociology all fall short because they look at selected elements and neglect others which are vital for the understanding of a composite social process that, in his view, may claim success if it maintains a balance of activities and population that can go on indefinitely. The solution of the population problem in Europe lies neither in the sacrifice of children to the pursuit of a highly artificial standard nor in the sacrifice of personal values to the prestige of the State; he seeks, rather, a balance. Perhaps he is not explicit enough concerning the mentality apt to spread when decline of population is imminent; we Europeans know its difficulties only too well from the case of France, 1923–1940.

This book touches briefly a great many, too many, topics, and thereby illustrates our difficulty in scientific study if we try to diminish the undoubted evils of highly selective specialization, but it has many thoughts worth pondering. The author wonders whether high net reproductive rates may not be associated with food rich in vitamin E; this is, perhaps, one factor but, so far, it would seem wise to moderate such claims. Like other writers, Mukerjee emphasizes the change from the mid-nineteenth century when the vast spaces of western North America seemed to offer limitless opportunities, to the present day when the misuse of some of those opportunities has brought such disastrous results, and he is concerned to show that the more thoughtful members of our populations must be encouraged to accept the responsibilities of parenthood.

The movement of people from the crowded monsoonal lands of Asia and its diminution since the economic catastrophe of 1929–32, with a partial revival for a short time in 1934–35, leads him to discuss the man-made barriers to immigration into the empty lands, and the relatively low birth-rates among important sections of the populations of North America, Australia and New Zealand. He thinks Asiatic peoples might spread a rice-economy in Central America, northern South America, the Guinea coasts of Africa, the south of the Congo basin and elsewhere, and that the East Indies could gain from large-scale immigration. Probably the peoples of European origin who have now spread beyond Europe and North America amount to 10 per cent of Europe's population. Asiatics outside Asia are not only a far smaller proportion of their home populations but also are actually much less than half the number of the Europeans who have spread beyond their two continents, and he pleads for "The Open Door". It is a serious plea and not an easy one either to refute or to accept.

H. J. FLEURE.

AMERICAN ARMY NATURALISTS

Ornithologists of the United States Army Medical Corps

Thirty-six Biographies. By Colonel Edgar Erskine Hume. (Publications of the Institute of the History of Medicine, the Johns Hopkins University, First Series: Monographs, Vol. 1.) Pp. xxv+583. (Baltimore, Md.: The Johns Hopkins Press, 1942.) 5 dollars.

IN this volume Colonel Hume has collected a great deal of interesting biographical information on thirty-six members of the United States Army Medical Corps, who at one time or another were connected with the study of birds. A few of the names are well known outside the United States, such as Charles Bendire, author of "Life Histories of American Birds", Robert Shufeldt, a great student of bird anatomy and contributor to Newton's "Dictionary of Birds", and Eliot Coues, a prolific writer and best known by his outstanding book "Key to North American Birds". The majority, however, are only known to students of works on North American birds, since much of their work was done during the Pacific railroad surveys, and different boundary commissions.

It was, indeed, fortunate that the Government appointed Prof. Spencer Baird, assistant-secretary to the Smithsonian Institution, as naturalist to the railroad survey, since he guided and encouraged the young medical officers who were attached to the different working parties in collecting and observing birds.

One ornithologist claimed by the Army appears as a surgeon in the Navy. This was J. H. Kidder, who began his career in the Army and later transferred to the Navy. In 1874 he accompanied the Transit of Venus expedition to Kerguelen, where he made extensive collections in all branches of zoology and botany. The results were published by the Government under the title of the "Natural History of Kerguelen". By the members of his profession Kidder is best remembered as the founder of the Naval Museums of Hygiene at Washington. It is difficult to understand how John Xanthus became assistant surgeon, and there is much mystery and romance about his career. It appears he was of a good Hungarian family, went to the United States about 1848 or thereabouts, joined the Army as a dresser, and became an assistant surgeon although he had no medical degree. On leaving the Army he served as consul for a short time in Mexico, and then returned to his native land. He does not seem to have been very reliable, but nevertheless Prof. Baird considered him an accomplished collector.

Apart from Shufeldt and Coues, the outstanding figure among the thirty-six names is Colonel E. A. Mearns, who died in 1916. It is computed that there are in the National Museum some 37,000 specimens of vertebrates collected by Mearns, and his contributions to the herbarium are greater than any other individual. Mearns, however, was no mere collector; he kept copious notes and, when time allowed, worked out his collections himself. His first important post was medical officer and naturalist to the Mexican Boundary Commission, and he also served in the Philippines for several years. When President Theodore Roosevelt went on his hunting trip in Africa, he applied to the National Museum for a collector, and Mearns was recommended as the best field naturalist and collector in the United States. The appointment gave every satisfaction, and many notes on game animals and birds in "African Game Trails" are from the note-books of Mearns.

THE VERTEBRATE RETINA

Vertebrate Photoreceptors

By Prof. Samuel R. Detwiler. (Experimental Biology Monographs.) Pp. viii+184. (New York: The Macmillan Company, 1943.) 4 dollars.

THERE is a fairly widespread belief, at least in Great Britain, that not only the brain but also the eye reaches its highest stage of evolution in man. Comparison of the human eye, with its capacity for colour vision, binocular vision and the resolution of fine detail, with those of the restricted group of mammals usually studied, does lend support to such a view, but if one turns aside to consider the eyes of the non-mammalian vertebrates it immediately becomes untenable. Granit's recent work on the differential sensitivity of the retinas of a selection of the lower vertebrates to different parts of the spectrum has shaken our belief that the perception of hue is the prerogative of the primates, some insects and, possibly, the birds. It seems most likely that an animal, such as the owl, with frontally placed eyes, must have binocular vision in spite of the complete decussation of its optic nerves, and no one who has watched a kestrel hover and then stoop on its prey can doubt that its visual acuity must be far higher than our own. Walls' detailed studies of the eyes of many vertebrates have led him to the conclusion that the eye of any given animal has usually reached that stage of development, or sometimes of regression, best suited to serve the needs of its mode of life, and the human eye does not appear to differ from any other in this respect. Man's superiority is not so much due to his better visual apparatus, as Elliot Smith suggested, as to his greater ability to make use of the information supplied by his eyes.

So far there has been but little interest in the eyes of non-mammalian vertebrates in Great Britain, and it is to be hoped that the appearance of Detwiler's new book on vertebrate visual cells, so soon after that of Walls on the vertebrate eye in general, will help to stimulate interest in a fascinating and much neglected subject.

In this book Detwiler is concerned with the structure, development and physiology of the retina, and particularly of its rods and cones. Much of the subject-matter is based on his own work but, on the whole, he is unusually generous in his appreciation of the contributions, both of observation and theory, of other workers. The exceptionally balanced and objective attitude adopted throughout the greater part of the book does, perhaps, result in a certain lack of liveliness, and it is possible that readers who are less concerned with a rather narrowly specialized subject than the reviewer may find it somewhat difficult to maintain their interest. The chapter on the evolutionary significance of the fovea, the only one in which the author comes out wholeheartedly on one side in a controversy (in this case against the theory propounded by Elliot Smith), is certainly the most entertaining. Sometimes, also, one cannot help feeling that Detwiler has gone too far in his kindly attitude towards some ideas which might be allowed

to disappear into a well-deserved obscurity. It is surely no longer necessary, for example, to discuss the possibility that the rods and cones are derived from the cilia lining the optic vesicle, since these are now known to disappear long before there is any sign of the developing visual cells.

The chapter on retinal photopigments is unexpectedly weak. Except for the discussion of Kolmer's droplets and their possible constitution, this chapter is based entirely on the work of Hecht and Wald, and the very important and fundamental work of Lythgoe and his colleagues on visual purple and the products of its bleaching is not so much as mentioned. Even the description of Wald's results is confused, although perhaps Detwiler should not bear the whole blame for this, since there are several discrepancies between Wald's earlier and his later papers which have never been properly cleared up. Attention must also be directed to the statement on p. 122 that "[Wald] showed—that the spectrum of pure rhodopsin (visual purple) corresponds in form and position with the spectral sensitivity of human rod vision computed at the retinal surface". Since no other name is mentioned in this connexion the implication is that Wald was the first to demonstrate this correspondence, yet the figure used on p. 121 to illustrate the point was actually published by Trendelenberg so long ago as 1904.

For the rest, the book is excellent and thoroughly reliable. There is a very clear and concise account of Polyak's investigations of the nervous structure of the retina, which is especially welcome since this worker's results are of the most fundamental importance to our understanding of the nervous physiology of vision and are by no means so widely known as they should be. The illustrations consist largely of photomicrographs, many of them made from the author's own preparations and most of them very good.

KATHARINE TANSLEY.

LANGSTROTH, THE APIARIST

The Life of Langstroth

By Florence Naile. Edited, with a Foreword and an Introduction, by Prof. Everett Franklin Phillips. Pp. 215. (Ithaca, N.Y.: Cornell University Press; London: Oxford University Press, 1942.) 15*s*. 6*d*. net.

BEEKEEPERS have waited a long time for a life of Langstroth, but Miss Naile has now produced a pleasantly written and well-arranged volume, attractively got up, which contains all that has been known about Langstroth and a good deal (especially about his ancestry and early years) which will be new to her readers. Prof. E. F. Phillips, professor of apiculture at Cornell University, has supplied the foreword and introduction, and the volume may be regarded as the official American 'life' of Langstroth.

The book has, however, been published during a great war and in consequence has suffered markedly from undue compression. We hope that if a second edition appears it will include more about Langstroth the man, as distinguished from the beekeeper. We should like to know more about him as a preacher, to see a photograph of him in the midst of his family and to know more about his wife and his children; at present the volume seems lacking in human feeling.

In other respects, too, lack of space seems to have made itself felt. When the controversy about Langstroth's patent was dealt with, the position as regards frames should have been explained, and the omission is the less excusable as Colonel Walker discussed the matter fully in a series of articles in the *British Bee Journal* of June 1, 1922, and reprinted in "Beekeeping New and Old", vol. 1, p. 126. Munn, too, and his hive should have been mentioned, as he was a friend of Dr. Bevan, that medical man whose portrait reminds one irresistibly of Pickwick, and whose "Honey Bee" was the best book about bees in its day (in the English language) and seems to have been the source from which Langstroth obtained his first ideas about systematic beekeeping.

Another point worth noting is that a frame is surrounded by six bee spaces; Langstroth first discovered the one above the frame and, later on, those at its base and ends; those on each side had been hinted at by Thomas Wildman (1768 Edn., p. 53).

On November 29, 1851, the *Gardeners' Chronicle* remarked of the American hives exhibited at the 1851 Exhibition, "North America is as fertile in rubbish as the mother country itself", and we think it is correct to say that Langstroth's service to his own generation was the simplification and partial standardization of the design of hives, which, by making them boxes for containing movable frames, enabled the beekeepers of that day to deal with the larger bee moth which, at that time, was reducing American apiaries to ruin. Later generations are inclined to regard him as the man who made extractors, comb foundation, swarm control and other essentials of modern beekeeping possible.

Langstroth's statement about "a small book, the author of which seemed to doubt the existence of such a thing as a queen bee" (p. 64) was quite correct but scarcely did justice to the first bee book he possessed. Jerome V. C. Smith, the author of "An Essay on the Practicability of Cultivating the Honey Bee in Maritime Towns and Cities", was a doctor of medicine who afterwards became mayor of Boston. The book is not a systematic treatise on the art of beekeeping, but it is extraordinarily suggestive and stimulating, and a comparison with the works of contemporary American authors will, we think, convince the reader that Langstroth was remarkably fortunate in his first bee book.

In conclusion, we venture to hope that Miss Naile will continue her study of Langstroth's life and work. We should like to see two more books on the subject from her. The list of Langstroth's library requires a good deal more emendation, and a booklet which dealt with it could be made very interesting. A study of "Langstroth on the Honey Bee" is also required. Americans should be helped to see how Langstroth showed capacity to discriminate between what was correct and incorrect in previous writers and whence he obtained his knowledge and, more especially, attention should be directed to any statements which appear to be original. The illustrations, too, should be examined. (The references are to the 1879 edition of Langstroth's book.) The picture of bees surrounding the queen which appears on the title-page was suggested by one which appeared on p. 48 of Dionysius Lardner (Museum of Science and Art, vol. 10, 1856); Fig. 65 on Plate XIII is Fig. 1 on Plate II of Dunbar's work and Fig. 55 is Dunbar's Plate IV reversed (The Naturalist's Library, vol. 6, Edinburgh, 1840); Fig. 51 on Plate XVI is Fig. V on Tab. XVII of Swammerdam (edition of 1758), and other examples would, no doubt, reward careful study.

H. M. FRASER.

The Carnivorous Plants

By Dr. Francis Ernest Lloyd. (A New Series of Plant Science Books, Vol. 9.) Pp. xvi+352 (38 plates). (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd., 1942.) 6 dollars.

THIS book is by far the most complete survey of the literature in a special, and naturally delimited, field; but it is also a contribution to knowledge in this field embodying many years of intensive work by a vigorous and original worker. Prof. Lloyd's own interest in carnivorous plants began with his studies of Utricularia, and in this monograph the descriptions of the organization and functioning of the many species in this genus and of the allied structures in the little-known genera Polypompholyx and Biovularia occupy a large proportion of the text. Prof. Lloyd's own contributions on the bladder of Utricularia extended considerably our knowledge of its structure and method of working, particularly as to the presence of the second valve membrane at the mouth, the velum, and its significance in facilitating the water-tight closure of the door necessary for the setting of the trap. When he extended his survey to cover other types of carnivorous flowering plants, besides making by far the most complete survey of the literature yet available, in every possible case he has examined material, living when possible, and in many cases as a result new facts are supplied as to development and structure, and he is able, from his first-hand knowledge of the plants under consideration, to give a critical and well-balanced survey of the work of earlier investigators.

Besides a number of text-figures, thirty-eight plates are included. These reproduce numerous original drawings and photographs. The drawings supply details of structure and development; the photographs usually illustrate habitat and have in many cases suffered in reproduction, in particular by the compression into a very crowded page.

In addition, the volume contains an interesting chapter reviewing the meagre facts available about some filamentous fungi which have either used the characteristics of their growth habit to weave hyphal snares for minute eelworms, or through the mucilaginous nature of their wall or contents immobilize and afterwards destroy various animalculæ.

Guide to the Stars

By Dr. Hector Macpherson. Pp. 137+10 plates. (Edinburgh and London: Thomas Nelson and Sons, Ltd., 1943.) 6s. net.

DR. MACPHERSON'S work has been produced primarily for the amateur astronomer, and its simple and lucid style renders it a very suitable book to place in the hands of the beginner. A brief outline of the universe, including the solar system, the galaxy and external galaxies, provides a useful introduction to the main portion of the work—a description of the constellations and their principal stars which are visible during the different seasons of the year. A number of star maps and also six plates at the end, containing eighteen constellations and stars down to the fifth magnitude, will prove very helpful to those who are anxious to learn the names of the stars. Chapter 9 is devoted to a description of the movements of the bodies in the solar system and contains a number of hints on the observations of the sun, moon and planets. A short account of eclipses, transits, occultations, the zodiacal light and the aurora borealis is given in the last chapter. The novice will find this small work an excellent introduction to the study of astronomy. There are a few slips of minor importance, of which the following may be noticed:

On p. 40 it is stated that the Great Nebula in Andromeda is the nearest of the external galaxies, but Messier 33 is a little nearer. P. 80, line 7 from top. This should read, "A line drawn from Zeta to Eta Ursae Majoris. . . ." P. 123. It is more correct to say that the maximum duration of a solar eclipse is about 7½ minutes, not 7 minutes. In the next paragraph, 111 days should read 11 days. M. D.

The Pocket Planisphere

By Francis Chichester. Pp. 4. (London: George Allen and Unwin, Ltd., 1943.) 2s. 6d. net.

THIS planisphere measures 5½ in. by 5 in. and can be carried in the pocket without the slightest inconvenience. It shows how the stars appear for each month on any selected day or hour to an observer in lat. 50° N. and also in lat. 35° S. On the rotating disk each month is divided into four portions, the first division being on the first of the month; and seven-day intervals are adopted in all cases except at the end of the months, when the arrangement necessitates intervals of nine or ten days. It is very easy interpolating and setting the planisphere for the selected day and also for the time of the night, intervals of one hour being used. As the space between successive hours is six-tenths of an inch, sufficient accuracy for fractions of an hour can be obtained. The names of the important navigation stars are in capitals and numbers are attached to other stars which the navigator may wish to use, a key to these numbers being printed on the back of the mask which covers the star disk. Directions for using the planisphere are supplied; it will prove a very useful equipment for the air navigator.

M. D.

Brompton Hospital Reports

A Collection of Papers recently published from the Hospital. Vol. 11, 1942. Pp. vi+136. (London: Brompton Hospital, 1943.) 5s. net.

VOL. 11 of the Brompton Hospital Reports contains fourteen recent articles published in the medical press by members of the hospital staff.

A. F. Foster-Carter contributes a well-illustrated report on "The Anatomy of the Bronchial Tree". "The Care of the Dying", by Clifford Hoyle, contains a great deal of information on points ignored by the standard works, and deserves a wider distribution than it is likely to receive in this specialized publication.

Physical Chemistry for Students of Biochemistry and Medicine

By Prof. Edward Staunton West. Pp. xiv+368. (New York: The Macmillan Company, 1942.) 28s. net.

THIS book is noteworthy for an excellent survey of recent developments in knowledge of atomic and molecular structure. The scope is wider than is suggested by the title, and it goes far beyond the requirements of the average medical student. It can be recommended as a book of reference for workers in biology and physiology.

SCIENCE IN CHUNGKING

By DR. JOSEPH NEEDHAM, F.R.S.

British Council Cultural Scientific Mission in China

THE present article is a continuation of the two recent contributions describing scientific work now going on in Yunnan province (south-west China). It will be followed by contributions on West Szechuan, on Kweichow and Kuangtung provinces (south-east China), and on the far north-west. It is hoped that by this means the mutual isolation of Chinese, British and American scientific workers may be mitigated.

Strictly speaking, Chungkirg itself is not a scientific centre any more than Westminster. The city, situated in a splendid position on a series of hills between the two great rivers where the Djialing joins the Yangtse, maintains its pride, and temporary houses have sprouted like bamboo-shoots all over the much-bombed areas. It has so often been described that a detailed account here is unnecessary, but the innumerable air-raid shelters blasted in the rock of the hillsides must be mentioned with praise. Life in the city is not so uncomfortable as is sometimes pictured, and always made agreeable by the unfailing good humour and spontaneous charm of the Chinese people themselves.

Among the Governmental organizations concerned with science, the National Resources Commission, presided over by the Economic Minister (himself a geologist), Dr. Wong Wen-hao, assisted by the able Mr. Chien Chang-chao, employs 165,000 workers up and down the country, and 12,000 administrative and technical personnel. Of the latter, more than 80 per cent are less than thirty-five years of age, including about 5,000 university graduates and about 400 technical and scientific experts who have spent many years in the West. The National Resources Commission is opening up natural resources everywhere in Free China, and its functions are to develop, operate and control basic industries, important mining enterprises, important electrical power enterprises, and also to administer other industrial enterprises as assigned by the Government. Like the Department of Scientific and Industrial Research in Britain, it subsidizes research in many universities, as well as research institutes. Then the National Health Administration, situated in a suburb, Bridgetown (place-names are purposely translated and garbled for security reasons), under Dr. Chin Bao-Shan, carries out the same functions as our Ministry of Health, and controls a National Central Medical Research Institute, to which I shall refer later.

In order to visit the important scientific work going on in the neighbourhood of Chungking, it is necessary to go out into the country some two hours motor ride in different directions. At Sandy Hook, for example, some distance up one of the great rivers which meet at Chungking, is to be found the National Central University, formerly at Nanking, but now occupying a site within the campus of the Szechuanese Chungking University. Both these universities push on with the teaching of scientific subjects in the face of rapidly dwindling supplies of essential chemicals and apparatus. In the chemical laboratory of the National Central University work is proceeding, under Prof. Kao Chi-Yu, on the parachor and on the effect of acids, bases and salts on the optical rotation of organic compounds; besides studies on oil paints and lacquer for aeroplane finishing. In the plant physiology and pathology department, Dr. Shen Chih-I (secretary of the Chinese Natural Science Society, an organization somewhat resembling our Association of Scientific Workers) studies the virus diseases of Chinese crop plants and the peculiar water requirements of rice varieties. In the biological department, Prof. Ouyang Chu pursues the studies on brain histology which he began with Oscar Vogt in Germany in former days, much handicapped by the damage which his microtomes suffered during the journey from Nanking. The physicists are also active. Dr. Sze Se-Yuan invents new cuprous oxide rectifiers, and means of making storage batteries locally, while also studying the production of permanent magnets with tungsten steel. Good work is proceeding, too, on the ultra-violet spectrum of the carbon monoxide molecule excited by bombardment with electrons (Messrs. Chao Kuang-Tseng and Yang Chun-Chung). Nor is mathematical physics neglected. Dr. Chang Tsung-Sui (formerly a pupil of Sir Ralph Fowler) is actively working on the theory of the meson, and papers by him have very recently been communicated to Great Britain through the British Scientific Mission in China.

Of the other institutions at Sandy Hook, Chungking University specializes in chemical engineering, in which subject Dr. Peng Shou-Ling (formerly with Sir Alfred Egerton at the Imperial College of Science and Technology, London) takes a prominent place. There is also the National Central Technical College, a Government institution for the training of working mechanical engineers, under Wei Yuen-Kuang as director. Among the laboratories of this College is one for hydraulic engineering and irrigation, reminiscent of what the friends of the Cambridge Geography School are accustomed to refer to irreverently as the 'mud-pie department'. But nothing could be more important for China, and this laboratory is suitably situated in Szechuan, the legendary home of the Great Yü, China's earliest irrigation engineer, who "mastered the waters" at the dawn of history, and worked so hard that "in ten years he passed the door of his house three times yet did not enter in". Finally, the famous Nankai Institute of Economics is also situated at Sandy Hook.

Undoubtedly the greatest scientific centre is a small town, Windbox Gorge, lying on another of the great rivers. Here there are no fewer than eighteen scientific and educational institutions, most of them of great importance.

To begin with, there are two Institutes of Academia Sinica, the Institute of Biology and the Institute of Meteorology. The former, under the leadership of Dr. Wang Chia-Chi, is extraordinarily active, with some twenty scientific workers fully occupied. Dr. Wang himself is a well-known protozoologist, and besides being head of the Institute, he directs the protozoolcgy department. The head of the department of vertebrate systematics is Dr. Wu Hsien-Wen: they are concerned especially with the taxonomy of the fishes, but also study fish ecology and physiology. Thus Chang Hsiao-Wei is studying interesting adaptations to life in mountain torrents (for example, the 'stone-climbing fish'), and Liu Chien-Kang the chloride-secreting cells in the gills of the paradise fish. Dr. Chen Shih-Hsien heads the entomology department; here work is proceeding on insect systematics, physiology (respiration, excretion, stridulation, etc.) and on the control of mosquito

larvæ by fishes and the insect-catching plant Utricularia (Miss Tan Chuan-Chieh). Dr. Rjao Chin-Chih, the algologist, heads the department of botany, which deals largely with the systematics of the higher plants, notably the Umbelliferæ. A visitor, admiring the situation of the Institute high above the great river, and viewing the work going on in it, feels that it has the true research atmosphere of the world's best laboratories.

The Institute of Meteorology is rather a charming contrast to that of Biology. It stands on a high hill-top far from the river, looking out over terraced rice-fields on all the slopes, and it needs much fewer workers. Under Dr. Lü Chung (director) and Chen Tze-Cheng, however, it is extremely efficient in amassing observations by regular balloon ascents, etc., and has an excellent library.

No less important than these institutes, and on a much larger scale, is the Chinese National Geological Survey. Its present director is Dr. Li Chun-Yü, and as the successor of the internationally known V. K. Ting (who presided over the discovery of Peking man) he has a distinguished position indeed. The Survey has three Divisions: that of Geology, which includes Palæontology, Mineralogy and Petrology, Geophysics and Seismography, and a Cænozoic Laboratory; that of Cartography; and that of Soil Science. The cartographical work (under Dr. Tseng Shih Ying) is very active, as also is the geophysical side. Here Dr. Li Shan-Bang has shown the greatest ingenuity in constructing seismographs, a pendulum apparatus for the measurement of g, and accurate clocks, literally with pieces of scrap metal and whatever can be got in Free China's west. He is now held up for photographic registering paper, which the British Scientific Mission (among very many similar efforts) is trying to secure for him. The palæontologists are constantly engaged in working over the very large numbers of specimens which the field expeditions of the Survey are always bringing in. Dr. Yin Tsan-Hsun described, for example, immensely rich triassic finds newly brought from Kweichow province.

The library of the Geological Survey, situated some miles away from the main building, on a hilltop in most beautiful country, is one of the largest and best equipped which I have seen anywhere in Free China.

Two other Government organizations of the first importance are to be found at Windbox Gorge. One is the National Bureau of Compilation and Translation (under the Minister of Education, Dr. Chen Li-Fu), and the other is the National Institute of Industrial Research. The first of these, presided over by the eminent scholar, Dr. Chen Ko-Chung, conducts an enormous work of standardization. For scientific men, its most important function is the settling of Chinese versions of scientific terms, a matter of great difficulty in view of the wide divergence between Chinese language and thought and that of the West, where modern science originated. Of these standard dictionaries, fifteen have already appeared (dealing with astronomy, mathematics, physics, mineralogy, embryology, and the like), thirty-two more are nearly ready to print, and thirty-three more are still in card index form. The method adopted is interesting. First, all the technical terms are card-indexed, with their various Chinese versions, then a choice is made, and finally the whole is sent out in the form of mimeographed ledgers to all the experts in the subject in question, who indicate their agreement or disagreement. If deadlocks occur, conferences are called. The Bureau employs no fewer than 200 workers, of which 130 are university men, including some very distinguished scholars, ex-presidents of universities. This work by no means exhausts, however, the Bureau's activities. It is also responsible for examining the text-books used in elementary schools, middle schools, etc., for compiling new encyclopædias and dictionaries, for translation of books (both from and into Western languages), for issuing collected editions of the classics, and for producing booklets of popular education for the masses. It is safe to say that no other Government, save perhaps that of the Soviet Union, supports such a wide programme of purposive scholarship. In the view of the Chinese Government, moreover, the Bureau needs enlarging to at least double its present size. Among the books officially translated have been Stebbing's "Modern Introduction to Logic", de Broglie's "Theorie de la Quantification dans la nouvelle Mecanique", Haas's "Einführung in die theoretische Physik", Crowther's "Ions, Electrons, and Ionizing Radiations", Howell's "Textbook of Physiology", Truscott's "Treatise on Ore-Dressing", and Sidney and Beatrice Webb's "Soviet Communism: a New Civilisation".

Imposing also in size is the National Institute of Industrial Research, which has other centres besides the main one at Windbox Gorge. Under the directorship of Dr. Ku Yu-Chuan, it comprises sixteen laboratories (fermentation, oils and fats, pure chemicals, motor fuels, analytical, colloid, cellulose, ceramics, plastics, tanning, machine design, electrical textile, strength of materials, heat power, forest products, sugar, salt and alkali). We can only glance at a few of these. In the fermentation division, Dr. Chin Pei-Sung manages the Chinese National Collection of Type Cultures, and much work is being done on acetone, alcohol and butyl alcohol fermentations. The pure chemicals division (Dr. Li Erh-Kang) produced five tons last year of all kinds of pure acids, alkalis and salts, but this is, of course, not nearly enough for China's research and production needs. In the forest products division, a remarkable effort has been made to recover the wood tar from the innumerable peasant charcoal-kilns all over the province. These have been fitted with bamboo condensers, with the result that many tons of valuable acetone and acetic acid have been made available, thus laying the foundations of an important decentralized wood-tar industry. The peasant coke-ovens are now being dealt with in the same way, which will be even more important. The plastics division has done pioneer work in the use of soya-bean oil-press cake as a basis for plastics, and many articles are now in production from indigenous waste protein and carbohydrate sources. The motor fuel division (Dr. Ku Yu-Djen) is doing fine work in the cracking of vegetable oils and the purifying of the gasoline so obtained. This Institute corresponds, therefore, to all the activities of the Department of Scientific and Industrial Research and the Research Associations of Great Britain rolled into one, but following our former analogy, the National Physical Laboratory and the Fuel and other Research Stations must all be considered as having been transferred, with the loss of most of their equipment and no locally existing facilities, to the shores of Loch Assynt!

The last important Government organization at Windbox Gorge is the National Agricultural Research

Institute, with its divisions of potato husbandry (in which the well-known American geneticist, Dr. Theodore F. Dykstra, is now working with Chinese colleagues), rice husbandry, soil science and plant pathology. In the last-named division, Dr. Chu Feng-Mei has constructed a very ingenious apparatus, almost entirely out of bamboo, for the separation of the round nematode-infested grains of wheat from the healthy elongated ones. In this way the parasites are not perpetuated when the seed is sown.

We come now to three non-Governmental institutions in this same place. First, the Science Society of China has its biological laboratory there in a secluded valley. It is actively engaged, under the veteran Dr. Chien Tsung-Su, on plant and animal systematics. This was the society which for many years published the Chinese equivalent of NATURE and *Science*, *Ko Shioh*. The editor, Lu I-Tao, is now in Chungking, and hopes are entertained of its early revival. Then there is the All-China Institute of Geography, an organization supported by the Sino-British Board of Trustees. Prominent in this Institute are Ling Chao (a former pupil of Prof. P. M. Roxby at Liverpool), who is shortly leaving for an expedition in Sinkiang, and Yang Kai-I (from Edinburgh) is also going as secretary to the head of the scientific survey of that province. Finally, there is Futan University, relatively small in numbers of students, but with a high academic reputation. Its laboratories are mainly devoted to teaching, but in biology Dr. Hsieh Fen is working on the growth-rate of cyprinid fishes.

Something must now be said of the scientific work at another place, Singing Stone Valley, away in the sandstone mountains through which the river cuts its course. Here are located the National Central Hospital, the Shanghai Medical College, and the National Health Administration's Research Institute. This last corresponds closely to the British National Institute for Medical Research at Hampstead, but in subject is more akin to the Wellcome and Lister Institutes. Its buildings are new, with a particularly good auditorium, hidden away among the wooded rocky hills with the ricefields at their foot. Among the various divisions under the directorship of Dr. Chu Chang-Kan there are nutrition (Wang Cheng-Fa), sanitary chemistry and engineering, medical entomology (Ho Chi), parasitology (Yuan I-Chin), pharmacology and bacteriology (Mrs. Wang Rjo-Yü) Excellent work is going on in all these.

The Shanghai Medical College ranks very high as a medical school, with the famous Peking Union Medical College, Hsiang-Ya (Yale-in-China) Medical School, and the medical colleges at Chengtu. The able administration of the pharmacologist and expert in Chinese drugs, Dr. Chu Heng-Bi, stands for an exceptionally thorough grounding in the fundamental sciences underlying medicine, and for the provision of opportunities for scientific post-graduate work. In the present rural surroundings and with so little equipment, this last requirement can scarcely be adhered to, but the staff of chemists and physiologists is exceptionally good, and the student level as high as anything so far seen in China. Thus the biochemists, Chi Yueh-Feng and Rjen Bang-Chih, were pupils respectively of Profs. Treat B. Johnson (purines) and H. B. Lewis (sulphur metabolism) in the United States. Among the students here are many from the now exiled Hongkong University Medical School, and they have one of their professors, the obstetric surgeon, Gordon King, on the staff at Singing Stone Valley.

In conclusion, the persistence and success of Chinese institutions with so little help and facilities again clearly appears. British science and Government alike should spare no pains to send help to those who are, among the United Nations, in science's 'front line'.

NON-SOLAR PLANETS

By DR. A. HUNTER

THE possibility that other stars besides our sun may possess planetary systems is one that has been the subject of speculation for centuries. Double stars in plenty are known, of course, and the orbital separations of the components are often of planetary order. In these cases, if the system is fairly close to the sun, the component stars are easily separable in big telescopes, and their angular separation can be measured directly with a micrometer. But the immensity of cosmic distances ensures that all stellar companions which can be detected directly in this way are of stellar brightness. No planet reflecting as little light (relatively speaking) as, say, Jupiter could be seen or photographed from our solar system even if it accompanied our nearest stellar neighbour.

This is not to say, however, that we are precluded from discovering planetary systems attached to other stars. There is the possibility, for example, that the gravitational effect of a planet can be detected from careful observations of the position of its primary. From such observations bodies of stellar mass have already been discovered: perhaps the most famous case is that of the faint companion of Sirius, the existence of which was deduced from the perturbed motion of its primary more than ten years before it was detected telescopically. The difference between this case and that of perturbation by a planet is evidently one of degree and not of kind. Only recently, however, have observations of the requisite accuracy become available. These are the photographic observations made at many observatories all over the world for the purpose of determining stellar distances.

The principle employed is that of parallactic displacement, as used in ordinary surveying, the base-line used being the diameter of the earth's orbit. Careful measurements of the apparent direction of a star on one night and of its direction six months later are combined with our knowledge of the size of the earth's orbit to give the distance of the star. In practice, the observations are delicate, for even the closest star has a parallax of less than a second of arc. The work must be spread over many years if small observational errors are to be reduced to a minimum, and in order to eliminate systematic errors of period one year, which would obviously vitiate the results, the measurements are made differentially, that is, the parallactic displacement of the star is measured not absolutely but with reference to faint distant stars in the background. In practice, the observation consists in securing up to half a dozen photographs at each of five or more epochs of maximum parallactic displacement. The photographs are then measured and the results analysed by introducing three unknowns—namely, a constant, the proper motion and the parallax—and solving by least squares.

But if the apparent motion of the star is not merely

a parallactic displacement superposed on a rectilinear proper motion, in particular if the star and an invisible companion are revolving around their common centre of mass, this procedure is not adequate. If it is in fact carried out (as it will be, in a routine observation, since we shall have no *a priori* knowledge of the presence of a companion), the residuals found from the measurements at the various epochs will show a systematic trend. The discovery of periodicities in certain parallax residuals was announced some years ago, but as has been recently pointed out[1], spurious periods of about two years are obtainable from almost all parallax measurements. They are indeed to be expected from general considerations: the method of reduction will tend to balance a large accidental residual at any epoch by residuals of the opposite sign a year earlier and a year later. Some recent work on two frequently observed stars, however, is based on accurate data extending back over some decades, and points very strongly to the presence of companions the mass of which is so small that they would be more accurately described as planets than as stars. It so happens that both these stars are visual binaries, so that the newly discovered companions make them into triple systems.

The system 61 Cygni consists of two sixth-magnitude stars making in 720 years a complete revolution in a large orbit with a semi-major axis of 25 seconds of arc. Extensive photographic observations of high accuracy, made over nearly thirty years, now reveal[2] small deviations from Keplerian motion which can only be explained by assuming that a third invisible component of small mass revolves around one of the main components. If the measurements are reduced on the assumption that the system consists of only two components, residuals are obtained which show a well-marked periodicity both in Right Ascension and in Declination, the period being 4·9 years and the amplitudes about 0·01″. The measurements are made only on the ***relative*** positions of the visual components *A* and *B*, so there is no way of knowing to which of them the perturbing member *C* is attached. However, the masses of *A* and *B* obtained from their known luminosities are practically identical, so that whichever is used in conjunction with the dynamical elements of the small orbit, the same result is obtained: the mass of *C* is only 0·016 times that of the sun, and the semi-major axis of its orbit is only 2·4 astronomical units (that is, 2·4 times that of the earth). The orbit is so eccentric that at periastron this invisible planet must come within 0·7 astronomical units of its primary. Allowance for the perturbation introduced by the third body removes the systematic trend of the residuals and halves their mean value. We have thus strong evidence for the existence in the 61 Cygni system of a body of mass only about sixteen times that of Jupiter. This is little more than one tenth that of the lightest known star (Krüger 60*B*, mass 0·14 sun), and the claim that the new companion should be regarded as a planet rather than as a star is evidently very weighty.

The other binary system in which a component of planetary mass has just been discovered[3] is 70 Ophiuchi. This consists of two stars of magnitudes 4·3 and 6·0 revolving in a relative orbit of period eighty-eight years and semi-major axis rather less than 5″. Careful study of photographs taken over a period of nearly thirty years shows periodic deviations from this binary orbit, the observations suggesting a secondary period of seventeen years and amplitudes of about 0·015″ in both *X* and *Y* co-ordinates. Again it is impossible to know to which of the main components the perturbing body is attached, but this time *A* and *B* are of rather different mass. If the planet revolves around *A* (mass 1·1 sun) the orbital radius will be 6·8 astronomical units and the mass of the invisible component 0·012 sun. If it is attached to *B* (0·7 sun) the radius of its orbit will be 5·9 astronomical units and its own mass only 0·008 sun. Here again, then, we have a third body, in what had hitherto been regarded as a binary system, with a mass of about one hundredth that of either of the visual components. In this case the claim of the newly discovered body to be regarded as a planet is even stronger: its mass is only about ten times that of Jupiter.

The state of astronomy is now such that by extending the programme of parallax observations somewhat, invisible planetary companions not much more massive than Jupiter could be discovered if they are in fact attached to the nearer stars. If systematic observations for this purpose were instituted by international co-operation after the War, it could be decided within a relatively short time whether planetary systems are or are not a rare cosmic phenomenon. A definitive answer to this long-standing query would obviously have an important bearing on theories of the origin of our own solar system.

[1] Jackson, J., *Mon. Not. Roy. Ast. Soc.*, **102**, 257 (1942).
[2] Strand, K. Aa, *Pub. Ast. Soc. Pacif.*, **55**, 29 (Feb. 1943). See also NATURE, **151**, 283 (1943).
[3] Reuyl, D., and Holmberg, E., *Astrophys. J.*, **97**, 41 (Jan. 1943).

UNITED NATIONS CONFERENCE ON FOOD AND AGRICULTURE

A BRIEF summary of the report and a list of attending delegates and of resolutions passed at the United Nations Conference on Food and Agriculture held at Hot Springs, Virginia, during May 18–June 3 has been published by H.M. Stationery Office*. The Conference was attended by delegations from forty-four countries. The British delegation of nine was under the chairmanship of Mr. Richard Law, Under-Secretary of State for Foreign Affairs.

"The Conference met to consider the goal of freedom from want in relation to food and agriculture. In its resolutions and its reports, the Conference has recognized that freedom from want means a secure, adequate and suitable supply of food for every man."

Freedom from want, the Conference declared, means more than freedom from hunger, but the attainment of the latter is a first essential step towards the attainment of the greater, ultimate good. The Conference recognized that to free the entire population of the world from hunger or malnutrition would require a greatly increased production of foodstuffs, but saw no insuperable technical obstacles to achieving the required level of production. Assuming that such obstacles as have existed in the past could and would be overcome by the technical ingenuity of man, the Conference proceeded to consider the less tractable problems of social and political organizations, on the solution of which the realization of universal freedom from want ultimately depends.

The results of the deliberations are contained in a series of thirty-odd resolutions, the text of which

* Final Act of the United Nations Conference on Food and Agriculture. Cmd. 6451. (London: H.M. Stationery Office, 1943.) 9d. net.

comprises the main part of the publication. A full report of the Conference has, apparently, been prepared, and reference is made to it, but it has not yet been published.

The first resolution is in the form of a declaration that the first task of the United Nations, after winning the War, will be to free the peoples of the world from hunger. The full attainment of this goal must be a long process, but essential thereto are greatly increased food production and economic regimes which ensure to all sufficient purchasing power to buy their necessary food. The responsibility that the people have enough food for health and well-being lies with the several nations, but each nation can fully attain the goal only if all work together. The resolutions of the Conference were framed to suggest the kind of machinery that might be set up to promote international collaboration in this vitally important field, and the kind of tasks with which the machinery will have to deal and to which it must be adapted.

The most important resolution of the Conference is that which recommends the setting up of a permanent international organization to promote such measures of food production and agriculture as will raise the levels of nutrition and standards of living of the peoples of the world. Recognizing the urgency of making a start, the Conference recommends the immediate setting up in Washington of an interim commission on which each of the participating Governments was invited to designate a representative before July 15, 1943. The interim commission would automatically dissolve when the permanent commission was established.

The main purpose of the interim commission would be to draw up and submit for the consideration of the participating Governments plans for the form and functions of the permanent organization. It would also formulate a declaration embodying the obligations of each nation to collaborate in the improvement of agriculture and in raising the standard of nutrition. Each Government would be invited to subscribe to this declaration.

The two paragraphs outlining the proposed scope and functions of the permanent organization are important enough to be quoted in full:

> "That in the preparation of a plan for the permanent organization the Interim Commission give full consideration to the following:
>
> (a) The relation of the permanent organization to, and methods of associating it with, other institutions, national as well as international, which already exist, or which may hereafter be established, in the field of food and agriculture and in related scientific, economic and other fields;
>
> (b) Provision for membership in the permanent organization, in due course, of governments not represented on the Interim Commission;
>
> "That in considering the functions and duties to be assigned to the permanent organization the Interim Commission take into account:
>
> (a) The promotion of scientific, technological, social and economic research;
>
> (b) The collection and dissemination of information and provision for the exchange of services;
>
> (c) The submission to member governments and authorities of recommendations for action with regard to the following:
>
> (i) Nutrition;
> (ii) Standards of consumption of food and other agricultural products;
> (iii) Agricultural production, distribution and conservation;
> (iv) Statistics and economic studies in the field of agriculture and food, including the study of the relation of agriculture to world economy;
> (v) Education and extension work in the field of food and agriculture;
> (vi) Agricultural credit;
> (vii) Problems of agricultural population and farm labor."

A further extension of the functions of the permanent organization into the fields of commodity control, agricultural co-operative movements and land tenure is also tentatively proposed.

It is this permanent organization, to be devised by the interim commission, which will give effect to, or provide the machinery whereby the several Governments can jointly give effect to, the resolutions of the Conference and other measures afterwards designed to bring the ultimate goal of the Conference nearer attainment.

The Conference further recommends that the several Governments should formally declare their intentions immediately to take measures to increase the food resources and to improve the diets of their peoples in accordance with the principles and objectives outlined at the Conference.

The fourth resolution recommends that Governments should undertake positive measures to improve the diets of 'vulnerable' social groups, namely pregnant and nursing women, children and large families in low-income groups.

Resolution V recommends that, whereas a diet at a level merely sufficient to prevent malnutrition is not enough to promote health and well-being, Governments should actively encourage the study of health in relation to nutrition and the dissemination of knowledge of correct feeding. Resolution VI refers to the prevalence of certain deficiency diseases and the need for taking measures to eliminate them and to prevent their recurrence.

Assuming that measures are taken to improve diets and to eliminate deficiency diseases, the Conference recommends (Resolution VII) that national nutrition organizations be established to ascertain the food-consumption habits and nutritional status of different sections of the population, with authority to make recommendations in the light of their findings. Resolution VIII recommends that these organizations periodically and freely exchange information and experience among themselves, and report the results of their investigations to the permanent commission; and Resolution X that the work and experience of organizations already existing for similar purposes should be fully used, whenever possible.

Resolution IX recommends that the goal of food policy in each country should be the optimal diet in quantity and quality, and that Governments should distinguish clearly between this goal and the more immediate goal of minimal diets, at which in many cases they will first have to aim.

Resolution XI recommends that the permanent commission considers questions relating to the production of certain non-food marine and agricultural products, especially those on which some countries ill-adapted to produce their own food depend as a main source of income.

Resolution XII recommends that, as a first step in overcoming the general shortage of food, every effort should be made by countries the agriculture of which can be expanded in the short-term period to increase the acreage under crops for direct human consumption, and even to hold back the rebuilding of depleted livestock herds as well as the production of other crops which compete for acreage with essential foods. This recommendation is made to both those countries where agriculture has, and those where agriculture has not, been impaired by the War. The Conference recognized that the first and most vital task for all will be to eliminate the post-war hunger that will ravage so much of the world. In order to make the best use of the inadequate supplies of food, fertilizers, agricultural machinery, etc., that

will be available for some years after the War, it is further recommended (Resolution XIII) that the several Governments affirm the principle of mutual responsibility for the increased production of essential foodstuffs to the utmost capacity of each country, the effective distribution of such foodstuffs, the prevention of speculation in food and other necessities under the anticipated conditions of scarcity, and the gradual adjustment of national agricultures to secure balanced expansion of production and consumption throughout the world.

Resolutions XIV and XV deal with the change-over from a short-term to a long-term agricultural policy. As a working basis the Conference recommends that national farming systems should be adapted to the natural and economic factors of the environment, and should be designed so as to maintain soil fertility and provide steady employment throughout the year. In general, this implies the adoption of mixed rotational farming. The evolution of such systems must be paralleled by the development of programmes of education and research and the provision, where needed, of technical assistance and adequate credit to the producers.

Resolution XVI makes specific recommendations for ensuring an adequate supply of credit to agriculture, and Resolution XVII stresses the importance of establishing farmer co-operative societies in all countries. Resolution XVIII recommends that surveys be made of existing systems of land texture. Resolution XIX enlarges on the importance of providing agriculture with efficient educational, research and technical services.

Resolution XX refers to soil erosion as "the greatest physical danger to the world's food production", and recommends that each nation undertakes the necessary economic and other measures to conserve its soil and water resources, while the permanent commission formulates the principles of soil conservation and facilitates the interchange between nations of conservation experts. Resolution XXI deals with the development and settlement of unproductive lands by drainage, irrigation, soil amelioration, etc. The permanent commission would perform a co-ordinating and controlling function similar to that envisaged in Resolution XX.

Resolution XXII recommends the development of subsidiary industries, internationally controlled emigration, and financial assistance in the intensification of agriculture in regions suffering from rural over-population.

Resolution XXIII recommends in the interest of international security the removal of barriers to the expansion of international trade.

Resolution XXIV makes suggestions for achieving an economy of abundance that read rather like an election manifesto. Resolution XXV recommends that the broad principles be formulated upon which international commodity arrangements should be based in order that such arrangements will contribute to the well-being of the peoples of the world, and proposes that an international organization be created for this purpose and to co-ordinate the operation of such arrangements in accordance with the principles agreed upon.

Resolutions XXVI and XXVII recommend special national and international measures for wider food production, special attention being given to the feeding of "vulnerable" groups and the making available of protective foods to all.

Resolution XXVIII recommends that the permanent commission investigates the practicability, and fosters the adoption, of international grade standards for agricultural and marine commodities with a view to a general improvement in the marketing and quality of food products. A wide extension of market research is advocated, and the taking of steps by the Governments concerned to protect both the producer and the consumer of food against the practices of those who regard them as legitimate prey.

Resolution XXIX recommends that the permanent commission studies the technical, scientific and economic problems of food processing, storage and distribution, and that steps be taken by each country to make full use of new technological processes developed since the War. Resolution XXX urges that the margins between the price to the producer and cost to the consumer be reduced by whatever means are practicable.

Resolution XXXI urges that the conclusions reached by the Conference regarding agricultural produce apply, whenever appropriate, to fish and marine products also, and that these subjects be considered equally by the permanent commission.

OBITUARIES

Prof. Antonín Šimek

FROM a reference in the *Chemisches Zentralblatt* to a notice by Prof. F. M. Jaeger in the *Chem. Weekblad* (August 22, 1943; **39**, 454), it is learned that Dr. Antonín Šimek, professor of physical chemistry at the Masaryk University of Brno, Czechoslovakia, must have died about a year ago.

Šimek, who was one of the foremost Czechoslovak physical chemists, was born at Nové Hrady in Bohemia in 1887, and studied at Prague and in Holland, where he made many life-long friends. With the establishment of the Czechoslovak Republic in 1918, he was called to the newly-founded Masaryk University and for many years was fully occupied with the equipment of his laboratories and in academic work, though he found time to conduct researches on tellurium and its oxides. During this work he observed a curious phenomenon that still remains unexplained. He fused tellurium dioxide on electrically heated platinum foil and noticed that the molten drops always move away from the negative pole and towards the positive one. The substance would even travel uphill and its velocity was proportional to the current. In attempting to repeat the experiment with selenium dioxide, which had to be heated under pressure, Šimek met with a serious accident.

Besides being a physical chemist of distinction, Šimek was also a keen mineralogist and he examined a number of Moravian minerals for their content of the rarer elements. Mention has been made of Šimek's connexions with Holland. He also made several visits to England and used English text-books with his students. For their benefit, too, he translated A. S. Russell's "Introduction to the Study of Radioactive Substances" (1925) and Bragg's "Concerning the Nature of Things", and he made a feature of lecturing upon contemporary work in science. Most of his work was published in Czech, but he also wrote in Dutch and occasionally in English journals.

In 1926 he married his assistant, Miss Hannah

Kadlcová, who shared not only his scientific interests but also his devout Protestantism, and both were interested in the Czechoslovak Student Christian Movement.

Šimek, who died at the early age of fifty-five, will be sadly missed when Czechoslovakia is again liberated and the Masaryk University of Brno is re-opened.

G. DRUCE.

WE regret to announce the following deaths:

Dr. Mary Jane Rathbun, honorary associate in zoology since 1915 of the U.S. National Museum, known for her work on the Crustacea, particularly the crabs, recent and fossil, on April 4, aged eighty-two.

Mr. H. L. Sikes, C.B.E., formerly director of public works, Kenya Colony, on May 23, aged sixty-one.

BRITISH AND RUSSIAN MEN OF SCIENCE

EXCHANGE OF GREETINGS

THE following message from Prof. Lena Stern, of the Academy of Sciences of the U.S.S.R., to British men of science was transmitted by the Embassy in London of the U.S.S.R. to the Royal Society. With the view of carrying out its intention, Sir Henry Dale, president of the Royal Society, has asked us to publish the message, so that it may reach a wide constituency of those for whom it is intended, together with the reply which he has forwarded to Prof. Stern through the Soviet Embassy.

Message from Prof. Lena Stern

On the day of the second anniversary of the War, I would like to tell you a little of how we Soviet scientists are carrying on to-day, working for our common cause of victory.

In this historic struggle of two worlds, of two world outlooks, of two diametric principles—good against evil, light against darkness, civilization against barbarity—our science has wholly devoted itself to freeing culture from the menace of Hitlerism, to defending the freedom of all nations.

Without exception, all our scientific workers—young and old, men and women—consider it their sacred duty to give all their strength and energy, all their knowledge and their very lives for this cause; and they fulfil their duty sublimely, disregarding all difficulties and all privations which the War has brought in its wake.

The work which is being carried on so intensively at our factories and mills, in our research institutes, in our university departments and in our war hospitals is wholly directed towards helping the front, to perfecting the arms of war, to protecting the health of our fighters. Our science is closely bound up with all the manifestations of the life of the people, both at the front and behind the lines, so much so that it is impossible to divide the man of learning from the fighter, just as it is impossible to divide the research institute from the factory.

It can be said without exaggeration that the heart of the whole people beats in unison with the front and that the slogan "Everything for the front" is not mere words but an actively motivated feeling of the entire people, of our multi-national State.

It is gratifying to be able to state that the theoretical achievements of our science now find wide and successful utilization in the defence of our country and in the strengthening of the fighting powers of our army. Personally I, with my pupils and associates, have since the first days of the War bent all our strength and knowledge to solving problems of the successful treatment of wounded fighters. I am happy beyond words that the results of our many years of theoretical researches now find application in the treatment of such dangerous complications attending injuries as those of shock and tetanus, as well as in accelerating the healing of wounds and the combating of fatigue.

One feels the greatest satisfaction at knowing that by our work to-day we are bringing nearer the hour of our common victory, bringing nearer the advent of peace under which creative work will be able to develop to its full force.

We must all remember that our peaceful, constructive endeavours, the labour of free men of science, can be ensured only by complete victory over the enemy. I believe this victory will come as the result of the joint offensive by the Allied Armies.

Warmest greetings to you, my friends.

Moscow, June 27. LENA STERN.

Reply by Sir Henry Dale, G.B.E., F.R.S.

The receipt of your message to British men of science has given great joy, and reminded me of my friendship with you, and our work together for international science, before the enemies of mankind inflicted on the world its present miseries, by their ruthless attack on the freedom and civilization of independent peoples.

Your stirring message came to me as president of the Royal Society of London, and, on behalf of all British men of science, I most heartily reciprocate your greetings and encouragement. We send to all the scientific workers of the U.S.S.R. an assurance of our full union with them, and with the men of science of all the great alliance, in a strong and fierce determination to use the utmost measure of our knowledge, skill and devotion to ensure and hasten the utter defeat of the enemies of freedom. We are equally determined that, with that defeat, conditions shall be established beyond danger of further attack, in which the scientific men of all nations may work for the greater happiness and health of all mankind.

Tell our comrades, the scientific workers of the U.S.S.R., that we, the scientific workers of Britain and of all the British Commonwealth, have been wholeheartedly devoted to these aims and these ideals during nearly four years of war, and with continued enthusiasm and growing confidence during these two years, in which we have known that our colleagues of the U.S.S.R. were our open and devoted allies in this tremendous war for freedom. We watch with unbounded admiration the achievements of the armies, workers and men of science of the U.S.S.R. for the common cause. We rejoice to know that we are marching together for the freedom of science and of the world.

With my friendliest personal greetings to yourself, and from all British men of science to all those of the U.S.S.R.

HENRY DALE (President).

Royal Society, July 7.

NEWS AND VIEWS

Department of Scientific and Industrial Research: New Director of Food Investigation

DR. CHARLES S. HANES, who has recently been appointed director of food investigation in the Department of Scientific and Industrial Research, was born in Canada in 1903 and graduated at Toronto. He entered Downing College, Cambridge, in 1925 as a Junior 1851 Scholar and was awarded a Senior Scholarship in 1929. He obtained the Cambridge Ph.D. degree in 1931. He was a research fellow of the Ontario Research Foundation during 1931–35, in which year he joined the staff of the Department of Scientific and Industrial Research at the Low Temperature Research Station, Cambridge. In 1942 he was elected a fellow of the Royal Society.

Hanes's first published paper was on resin formation in seedling conifers (*J. Linn. Soc.*, 1927), and his subsequent papers have dealt with various phases of carbohydrate metabolism, more especially the action of the enzymes involved in carbohydrate breakdown and synthesis. The culminating point of his researches (to date) was the "Enzymic Synthesis of Starch from Glucose-1-Phosphate" (NATURE, **145**, 348; 1940). Hanes thus achieved the production of starch from sugar as a laboratory process. In collaboration with W. T. Astbury and F. C. Bell, Hanes showed that synthetic starch was indistinguishable by X-ray analysis from natural starch (NATURE, **149**, 558; 1940). In 1941 Hanes was sent by the Department of Scientific and Industrial Research to Canada and the United States with the object of facilitating the exchange of scientific and technical information relating to the preservation of foodstuffs. Later he was lent to the Ministry of Food for service with the British Food Mission in Washington. On the formation of the Advisory Committee on Dehydration of the Combined Food Board, Hanes became its chairman.

Johnston Chair of Biochemistry at Liverpool: Retirement of Prof. H. J. Channon

PROF. H. J. CHANNON, who is leaving the Johnston chair of biochemistry in the University of Liverpool at the end of the present academic year to take up an appointment with Unilever Ltd., is a recognized authority on fats and fat metabolism. After graduating in both arts and science from University College, London, he worked in the biochemical department there, either alone or with various colleagues, on the biological significance of the unsaponifiable matter of various liver oils, on cholesterol metabolism and on the nature of the lipoid constituents of cabbage leaves. This latter research led to the isolation of two new interesting compounds, diglyceride-phosphoric acid and dimyristyl ketone. Throughout this period he displayed a marked keenness for teaching as well as for research, and on being called to succeed Prof. Ramsden at Liverpool in 1930 he was able to give full vent to both these urges.

Giving at first a priority to teaching, Channon reorganized the biochemistry courses for the medical students and particularly for those taking the B.Sc. degree in the subject; his efforts here have undoubtedly borne fruit, and until the inevitable interruption by the War, a steady stream of well-trained graduates came from his department to find employment in academic research or in industry. Many collaborated with him in his own researches, which dealt *inter alia* with the fate of injested hydrocarbons, the desaturation theory of fatty acid metabolism and the effects of various factors in the production of dietary fatty livers. A clear and convincing speaker in lecture or discussion, Prof. Channon's transfer to industry will leave a gap in academic circles that will be hard to fill. He leaves, nevertheless, with a wide experience of research on fats and related substances which should enable him to make the fullest use of opportunities that lie ahead, and his former colleagues will wish him all success in his new venture.

Future of the British Colonial Empire

AN important statement on the future of the British Colonial Empire was made in the House of Commons on July 13 by Colonel Oliver Stanley, Secretary of State for the Colonies. Colonel Stanley said that the foundations of political responsibility in the Colonies must be based on the twin pillars of educational advance and economic development. The Colonial universities would have an important part to play in advancing higher education; they would have to produce leaders, and also do an increasing amount of research. The universities of Great Britain can help in this development, and the institution of a kind of lend-lease intellectual service between them and the universities of the Colonies would result in many advantages to both parties. A commission of inquiry under the chairmanship of Sir Cyril Asquith is being set up to consider how this co-operation can be best achieved. Another commission, under Mr. Walter Elliot, will consider higher education in British West Africa; African representatives of the areas involved have been invited to serve on this commission.

Dealing with the more general topics of economic development and administration, Colonel Stanley said the work of labour advisory boards has enabled the two sides of industry to meet and has encouraged the principle of collective bargaining. Some three hundred trade unions are now in existence in the Colonies. It is hoped to open a course, extending over two years, at the London School of Economics, on training for leadership in societies, and open to people from the Colonies, and particularly Africans and West Indians. So far as development is concerned, Colonel Stanley said that a special department is being created in the Colonial Office to deal with communications, and special interest is being taken in air transport. Industrial development will, he believes, depend upon private enterprise, under proper control.

In replying to the debate, Colonel Stanley added an important note on Colonial administration. He said that while the Government is convinced that such administration must continue to be the sole responsibility of Great Britain, it is desired to work in close and friendly co-operation with neighbouring and friendly nations. To this end, the Government is considering the possibility of establishing commissions for certain regions, these commissions to consist of representatives of States with Colonial territories in the region and of other States with major economic or strategic interest therein. Each State would remain responsible for the administration of its own territory, but such commissions would provide permanent machinery for collaboration in promoting the welfare of Colonial territories generally. Colonial peoples would be associated with

the work of the commissions. The formation of such commissions would be a great step forward in promoting the international recognition of trusteeship, as opposed to ownership, of Colonial territories.

Aspects of Demobilization

THE important address of Sir William Jowitt to representatives of municipal and business interests of Merseyside, delivered in Liverpool on June 17, directed attention to a vital but complex aspect of post-war reconstruction. The complexity of the problems of demobilization should be apparent to all, but Sir William Jowitt's remarks on the subject were reassuring in that he said that the fatal mistakes of 1918–19 will not be repeated. Sir William urged that it would be foolish to involve members of the Fighting Forces in any controversy about rival schemes of demobilization; past experience justifies the reminder that it would be highly dangerous. The very difficulty of devising a fair and efficient scheme of demobilizing in the shortest possible time a huge number of men and women and resettling them in peace-time work in industries, most of which would be short of raw materials, while many of the factories would require re-tooling and re-arranging, makes it imperative that a policy should be decided upon promptly and that it should be explained intelligently as soon as possible to prevent misunderstanding later on. Sir William Jowitt stated that the Government has adopted a scheme in which the guiding factors are age and length of service. Clearly, however, demobilization cannot be based entirely on these principles. The necessity for armies of occupation, apart from the probability of the war with Japan continuing after Germany has been defeated, will involve a partial demobilization, and the release of men may have to be determined to some extent on transport grounds, for example. Similar considerations may apply to industry. A more orderly transition from war to peace than in 1918 means that some workers will be more urgently required than others when peace-time industry is starting up and the process of re-equipment and reconstruction commences.

The *Economist* has indicated some broad principles of industrial demobilization that merit consideration. Capacity capable of working directly for export should be freed from war obligations as soon as possible. Food, clothing and shelter should come before luxuries. Industries capable of being reconverted to peace work without expensive re-equipment and re-tooling should be allowed to turn over as soon as practicable, to economize the resources needed for immediate reconstruction. British demobilization, both of machines and men, should be an integrated part, not only of the continuing war effort of the United Nations, but also of the joint plans made by them for relief and reconstruction on a world scale. The service of such principles leaves no room for pointless argument, but equally it demands of the Government prompt decisions which must be made known and fully explained. In demobilization—and indeed in reconstruction generally—the channels of assent can never be dug too deep if acrimony is to be avoided.

Association of Teachers in Technical Institutions

AT the annual conference of the Association of Teachers in Technical Institutions, held in London during Whitsuntide, Mr. J. C. Hazelip of the Leeds College of Commerce was inducted as president of the Association. It is some fifteen years since a teacher of commerce was elected to the office. In his presidential address Mr. Hazelip referred to the additional work undertaken by technical colleges during the War. It includes training of R.A.F. and Royal Navy personnel in radio work and of the R.A.O.C. and the R.E.M.E. for the many maintenance jobs which a mechanical army needs in the field. There is also the training of members of the A.T.S. for clerical and other work. Mr. Hazelip stressed the importance of this contribution by the technical colleges to the national war effort "since success in modern warfare is largely a matter of being in possession of the necessary equipment and of the technical skill to keep it in working order". Thus, he said, the work of technical education is an important factor in bringing the present struggle to a successful issue. He stressed, too, the fact that this additional work had gone on "without interference with normal technical college activities". With the possibilities of an Education Bill in mind Mr. Hazelip sketched arguments against merging junior technical and commercial schools into a "multilateral school". Technical education, he said, must be conducted in an atmosphere of realism and must be able to call upon the services of men and women who themselves had experienced the difficulties and problems "inherent in the spheres for which the students are being prepared educationally". Technical education must be dovetailed into the industrial and commercial life of the community round it. This realistic atmosphere, he said, could not be found in the normal secondary school. He insisted, however, that notwithstanding the realism of its approach, the junior technical school in its work in English subjects, science and foreign languages, would stand comparison with any similar work now being carried on in any other type of post-primary school.

War Background Studies

No. 7 of the series of Smithsonian Institution War Background Studies, by J. F. Embree, is devoted to an account of the Japanese nation, its origins and present social structure. The reader is assumed to have some familiarity with Japanese art and literature, costume and types of building. The economic framework of the lives of the people is only very briefly touched upon, and nothing is said about the physical geography or climatic conditions of the country. On the other hand, nearly half of the 36 pages are devoted to the family and household structure and to the customs surrounding the events of the individual life from birth to death, and there is a short chapter on religious beliefs. The author is of the opinion that the obvious differences between the mental processes of adult Japanese and Americans are solely the result of these customs, outlook, and beliefs. Perhaps the most helpful and charming feature of this brochure is its sixteen excellent photographic plates.

No. 8 of these Smithsonian pamphlets, by H. G. Deignan, gives an account of Siam and its inhabitants. In this case a description of the geographical setting is given, and the whole work might be considered as an introduction, but little more, to what would indeed prove a very interesting study. The region dealt with can be divided into a northern, an eastern and a central area, the latter passing down southwards into the Malay peninsula to the frontier of the Straits Settlements. The aboriginal Negrito popula-

tion can to-day only be found in isolated groups in the hills: at least three migrations from the north having at various times overrun the land. It was but a few centuries ago that a number of petty kingdoms arose, and only comparatively recently that what can be called a real national feeling has developed. Siam is a country little known to the average white man. It merits somewhat more detailed treatment than has been possible in these 18 pages. The illustrations, once again, are delightful.

Work of the Tennessee Valley Authority

THE article "T.V.A. An Achievement of Democratic Planning", by Dr. Julian Huxley, which occupies the greater part of the June number of *The Architectural Review*, should be of wide interest in view of the absence in Britain of adequate descriptions of the work of the Tennessee Valley Authority. This concise but comprehensive account of T.V.A. in all its implications, which is illustrated by many photographs, most of them new, gives a striking demonstration of the possibilities of judiciously and democratically applied regional planning. The article is timely, for in the post-war planning which must be undertaken in Great Britain we cannot afford to neglect the experience gained in ten years work on the world's boldest venture in regional reconstruction. Moreover, Dr. Huxley includes a critical examination of the limiting conditions of such democratic planning and stresses the essential characteristics: the making of the greatest number of decisions on the spot; development so far as possible of the active participation of the people themselves; co-ordination in the field of the work of all the other agencies concerned; and decentralization of the idea behind an administration so that its planning becomes a part of public opinion. The provision of full powers for a limited function with the organization developed, and the special methods of survey and system of research deliberately adjusted to consumer needs, are all new tools, as Dr. Huxley points out, which will be of service to any democracy in its struggle to control its own social destiny.

Scientific workers will be particularly interested in Dr. Huxley's concise account of research carried out by the Tennessee Valley Authority. In its chemical laboratories a method has been worked out for extracting aluminium from certain common types of clay, which has reached the pilot plant stage, and work on the extraction of magnesium from olivine is also coming to the pilot stage. In the biological field, valuable research has been carried out on malaria control, the incidence of malaria and the encouragement of fish life. The most important aspect of its agricultural research is concerned with the prevention of erosion, including the growing of new cover-crops, while the investigation devoted to the perfecting of agricultural machinery is an excellent example of research carried out and applied from the point of view of consumer interests. This has led, for example, to an electric hay-drier, costing less than 10 per cent of the previous cheapest drier on the market, and a cheap furrow seeder. Elaborate experiments have been conducted to discover suitable trees and shrubs which will yield crops of fruit or nuts suitable for direct human consumption or available for pigs or other animal stock. Much research has been put into the development of a new type of pressure-cooker for producing cotton-seed meal and oil. Other research has led to the development of quick-freezing machinery suitable for use by farmers' co-operatives, which has much increased the growing of various fruit crops. The planned surveys of the Authority are of equal interest, and a new type of land classification has been worked out with the co-operation of the National Resources Planning Board: and a land-use survey has also been prepared for the most important areas of the Tennessee Valley.

Aid for Chinese University Students

THE International Student Service Committee in Chungking is a constituent member of the National Student Relief Committee, which works in close co-operation with the Chinese Government and enjoys the full support of the United Aid to China Fund in Great Britain. Among other schemes, the National Student Relief Committee has organized a system of national scholarships, under which two hundred select students receive free maintenance, university education and constant tuition. The International Student Service Committee in Chungking has made itself specially responsible for the creation of a student centre at Shapingba, near Chungking, for refugee students from the occupied zones, and from all parts of Free China. A large percentage of them is homeless and penniless; others receive small grants for food, books, clothes and university fees. A well-stocked library is maintained for them; discussion groups are run on many subjects, including economics, diplomacy and current international topics.

The International Student Service in Great Britain (11D, Regent Street, London, S.W.1) has during past years sent out regular appeals in aid of the universities of China. It has been able to send out more than £1,000 annually, and hopes to be able to continue this assistance. Any amount collected is now being passed on to the United Aid to China Fund, which has promised to transfer the donations and to make recommendations to Madame Chiang Kai Chek, in whose hands lies the allocation of funds in China. Further information concerning its activities in this connexion can be obtained from the Secretary of the Service, at the above address.

Protection from X-rays and Radium

THE revised edition of the recommendations of the British X-Ray and Radium Protection Committee (32 Welbeck Street, London, W.1) embodies no drastic changes from the previous issue of this report. Certain precautions have been made more precise, and data relating to more powerful X-ray apparatus and larger quantities of radium used as mass units have been included. Thanks to these recommendations, the extension of irradiation methods into industrial practice should not be followed by an increase in the band of X-ray martyrs who suffered during the early years of the introduction of these methods into medicine. Attention is directed in the report to special Defence Regulations relating to the precautions to be observed by all those engaged in painting objects with radioactive fluorescent mixtures. Although reference is made to the desirability of systematic blood-tests and the measurement of the concentration of radon in expired air, it is strange that no recommendation is made for the periodical inspection of the hands of persons habitually engaged in the manipulation of radioactive preparations or containers. Another apparent omission is the

neglect to direct attention to the dangers attending the surgical use of diathermy apparatus in the presence of ether vapour. The thanks of all workers in the field of radiology throughout the world are due to the British X-Ray and Radium Protection Committee for its pioneer and continuing labours in this field.

Vitamin C Content of Oranges

IN the issue of the *New England Journal of Medicine* of January 7, Dr. Arthur D. Holmes, James A. Patch and Francis Tripp of the Research Laboratories of E. L. Patch Co., Stoneham, Mass., record their observations on the relation of season, weight and price to the vitamin C content of oranges. They found that there was considerable seasonal influence on nutritive value, the oranges being heavier and containing more juice at a lower vitamin C cost in December than at any other seasons of the year. The cost of 75 mgm. was 4·8 cents in March, 5·9 cents in June and September and 3·6 cents in December. The average purchaser, therefore, cannot use the size or cost of oranges as a reliable guide to the amount of juice or to the cost of the daily requirements of vitamin C.

New Zealand Earthquakes

DURING March 1943, fifteen strong earthquakes were registered by the seismographs at Auckland, Arapuni, Bunnythorpe, Christchurch, Kaimata, New Plymouth, Tuai and Wellington, all stations participating in the New Zealand Seismological Service and sending records or readings to the Dominion Observatory at Wellington (New Zealand Seismological Report—Provisional Bulletin, No. *P* 133, 1943, March). The records are remarkable in that eight of the shocks had a depth of focus greater than normal. The first, on March 4, had an epicentre south of Fiji and a depth of focus near 600 km. The shock of March 11 with epicentre east of New Caledonia had a depth of focus near 100 km. Earthquakes on March 15 and 21 have already been reported in NATURE, the data coming from the U.S. Coast and Geodetic Survey. On March 26 a very strong earthquake with an epicentre south-east of Tonga had a focal depth of between 80 and 100 km. It was reported to have been felt at Nukualofs, according to a message from Apia. The earthquake gave very large amplitudes on the vertical components of seismographs. Further, there was minor seismic activity, and 22 earthquakes or earth tremors were reported as having been felt (additionally) in New Zealand. The greatest of these shocks was Scale VI on the Modified Mercalli Scale. It occurred on March 14 and was felt in the southern part of South Island. Two earthquakes were felt with Scale V intensity. The first, on March 1, was felt from Te Kuiti and Waipawa to Greymouth and Rakaia. The second, on March 25, was felt at Westport. One shock was felt with Scale IV intensity and the rest with lesser intensities.

Earth Tremors in Portugal

EARTH tremors accompanied by earthquake noises were reported from Oporto, Braga and Viana do Costelo in north Portugal to have taken place on the night of June 22. Although these tremors caused some apprehension, they did not last long and no serious damage has been reported.

Centenary of the S.S. *Great Britain*

ON July 19, 1843, in the presence of the Prince Consort, the famous *Great Britain* was floated in the dock at Bristol in which she had been under construction for four years. As the first iron ship built for the Atlantic traffic, as the first ocean-going screw ship, and as by far the largest iron ship built up to that time, she stands out as a magnificent specimen of the art of shipbuilding as carried out by far-sighted, energetic and unprejudiced men. She was 322 ft. long, 50½ ft. wide and at a draught of 18 ft. had a displacement of 3,618 tons. The credit for her construction belongs to Captain Christopher Claxton, R.N., secretary of the Great Western Steamship Co., the famous engineer I. K. Brunel, William Patterson, a Bristol shipbuilder, and Henry Richard Guppy, another Bristolian who afterwards did good engineering work in Italy. When completed in 1845, the *Great Britain*, after being visited by Queen Victoria, took her place beside the *Great Western* on the Atlantic and made several crossings. Unfortunately, in September 1846 she ran ashore in Dundrum Bay, Co. Down, but was salved a year later. She was refitted as an auxiliary screw ship, and for many years employed on the Australian run. In 1882 she was converted into a sailing ship. Her active service came to an end four years later, when after a severe buffeting off Cape Horn she put into Port Stanley, Falkland Islands, where she became a wool hulk. Up to 1938 at least, she was still so used, an eloquent testimony to the quality of her iron hull and the workmanship of the Bristol shipbuilders.

National Research Council, Canada: Scholarships

THE National Research Council, Canada, announces the award for the academic year 1943–44 of 14 fellowships of the value of 750 dollars each, 30 studentships of 650 dollars each and 21 bursaries of 250 dollars each. The sixty-five successful candidates for these post-graduate scholarships comprise graduates of fifteen Canadian universities, and they will carry out research work in the coming year at eleven of these institutions. As a result of war conditions, the fields of science in which the scholarship holders will work are reduced in number as compared with a few years ago. By far the greatest number will work in various branches of chemistry related to the war effort. According to a general classification adopted in announcing the awards, 49 will study chemistry, 6 physics (including one radiology), 4 biochemistry, 2 genetics, and one each biology, mineralogy, mechanical engineering and electrical engineering.

Announcements

THE following have been elected officers and members of council of the Institution of Electrical Engineers for the year 1943–44: *President:* Sir A. Stanley Angwin; *Vice-Presidents:* Mr. T. G. N. Haldane, Dr. E. B. Moullin; *Hon. Treasurer:* Mr. E. S. Byng; *Ordinary Members of Council:* Brigadier F. T. Chapman, Mr. J. Hacking, Mr. A. L. Lunn, Dr. J. L. Miller, Mr. J. S. Forrest, Mr. E. C. S. Megaw, and Mr. E. Leete.

WE have received a copy of the revised pamphlet "Photography as an Aid to Scientific Work" from Ilford Ltd., Ilford, London. This gives lists of plates, films and papers suitable for all branches of scientific work, including medicine and surgery, clinical photography and radiography. There are also notes on filters and darkroom safe-lights.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Factorial Analysis of Physical Growth

THE 'Harvard growth study'[1], based on measurements of the same children year after year, is a type of co-operative research which urgently needs repeating in Great Britain. There are, however, one or two conclusions to be drawn from the American data which the investigators themselves seem to have overlooked. Until recently, it has been commonly supposed that there is no general factor entering into physical growth analogous to the general factor entering into mental growth[2], and no convincing evidence for the existence of group-factors, distinguishing human body-types, analogous to the well-established group-factors found in work on temperament, mental imagery, and the like (ref. 1, p. 291 and refs.). That physical development should proceed so differently from mental development would be somewhat surprising; but a glance at the literature shows that statistical methods adopted by Kretschmer, Spearman, and others in studying relations between physical measurements were scarcely as adequate as those now employed to establish mental types and mental factors in the field of individual psychology.

On applying the newer technique of 'multiple factor-analysis' to physical measurements, obtained from groups of English school children and students, I found strong *prima facie* evidence both for a general factor and for type-factors[3]. Similar results have since been obtained with groups of a different racial composition: Dr. J. I. Cohen, at my suggestion, analysed measurements for a Jewish sample, and reported the results in these columns[4]; more recently, Mr. W. H. Hammond has reached the same conclusions with measurements collected from Welsh adults by Prof. H. J. Fleure and from Irish adults by Mr. Mogey[5]. But perhaps the most interesting confirmation of all is to be found in the Harvard data, where correlations are available for a far larger group, comprising more than five hundred 16-year-old American youths (ref. 1, p. 301). On applying the same technique as before, I find, first a general factor accounting for more than 60 per cent of the total variance, and secondly a bipolar factor distinguishing persons showing relatively excessive growth in 'vertical' directions (height, length of leg, arm, or trunk) and those showing relatively excessive 'transverse' or circumferential growth (iliac width, chest width, chest depth, weight). The second factor points to much the same distinction as that drawn by earlier French and Italian physiologists, and popularized by Kretschmer's work on psychotic patients, namely, the distinction between asthenic, leptosomic, or microsplanchnic types and pyknic, eurysomic, and megalosplanchnic types respectively.

The confirmation is the more remarkable because the American investigators themselves regard their measurements as "illustrating the futility of trying to describe any but extreme cases as types". Like so many, however, they interpret 'types' as implying sharply discriminable classes rather than relative or partial tendencies; and they make no attempt to eliminate the obscuring influence of the more powerful 'general factor'. How far the so-called types may be due to racial, genetic, or endocrinological 'factors' is a question which statistical analysis alone is not competent to determine. It may be added, however, that the discovery of factors of two kinds, one influencing size, the other proportion or shape, is fully consistent with the distinction between isogonic and heterogonic growth in lowlier animals[6] and with the theory of two fundamental forms of growth recently put forward by Smalhausen at the Institute of Experimental Biology at Kiev.

University College, London. CYRIL BURT.

June 18.

[1] Dearborn, W. F., Rothney, J. W. M., and others, "Predicting the Child's Development" (1942).
[2] Spearman, C., "Abilities of Man", p. 141 (1926). Thomson, G., "Factorial Analysis of Human Ability", p. 280 (1939).
[3] Burt, C., *Brit. J. Med. Psych.*, **17**, 184–187 (1938).
[4] Cohen, J. I., NATURE, **144**, 944 (1939).
[5] Hammond, W. H., *Man*, **42**, 4–11 (1942).
[6] Huxley, J. S., "Problems of Relative Growth" (1932).

Semi-conducting Properties of Stannous Sulphide

SEMI-CONDUCTING properties of metallic oxides have received considerable study in recent years and have contributed largely to the theory of defect structures. By comparison, little attention has been paid to the heavy-metal chalcogenides, although their pronounced semi-metallic properties (for example, lustre, very high conductivity) suggest that among them, if anywhere, might be found the intrinsic Wilson semi-conductors[1]. In this connexion, a special interest is attached to such compounds as lead sulphide and stannous sulphide, in which the cations possess unutilized valency electrons, which might well contribute to the metallic conduction. With this in mind we have studied the conducting properties of stannous sulphide, and present here our main conclusions. A fuller account and discussion of the experimental data will be published elsewhere.

In agreement with an isolated measurement by Tubandt[2], stannous sulphide is an electronic conductor at all temperatures. Even at the highest temperature investigated (750° C.), the ionic component of the conductivity certainly does not exceed 1 per cent of the total conductivity. Preliminary observations show that no pronounced increase in conductivity accompanies fusion (melting point of stannous sulphide, 870° C.), so that the liquid is probably a semi-conductor also.

Variation of conductivity with temperature can be represented by a two-term formula

$$\varkappa_{I_2} = Ae^{-E_1/RT} + Be^{-E_2/RT}.$$

The high-temperature conductivity is reproducible from one specimen to another, and independent of past history; $E_1 = 12{,}600$ cal. This presumably corresponds to intrinsic semi-conduction. At lower temperatures (for example, below 300°), impurity conduction supervenes, and the manner in which the number of conducting centres and the activation energy E_2 depend on the previous treatment of each specimen indicates that under these conditions positive hole conduction takes place, in a non-stoichiometric crystal.

This may be exemplified by the accompanying data. Treatment of one particular specimen with pure hydrogen increased $R_{18°}$ almost 2,000-fold. Exposure at the ordinary temperature to air, or to hydrogen

containing a trace of oxygen, or reaction with hydrogen sulphide, led to a rapid increase of conductivity. This clearly points to the taking up of oxygen or sulphur which, once incorporated in the crystal as oxide or sulphide ions, can be removed only by reduction at temperatures above 300°.

We infer that stannous sulphide is non-stoichiometric, with a range of composition on the sulphur-rich side of the ideal formula. In accord with the variable valency of tin, a certain proportion of tin atoms are raised to a higher valency (on energetic grounds trivalency appears more likely than quadrivalency, although no compounds of trivalent tin exist), and a corresponding number of cation sites are left vacant. Each such positive hole is potentially a conducting centre, which can migrate through the lattice by switches of the excess charge from cation to cation. Assuming a reasonable value for the mobility of an electron in stannous sulphide[3], our figures indicate that 'equilibrium' stannous sulphide, that is, stannous sulphide exposed to oxygen, or heated in hydrogen sulphide to 300°, contains between 1 in 1,000 and 1 in 100,000 excess anions. At ordinary temperatures this confers a conductivity far outweighing the intrinsic conductivity, since the conduction band lies about 0·55 volts above the highest occupied level.

Treatment of Stannous Sulphide	$R_{18°}$ ohms	$K_{18°}$ mhos	E_2, cal.
Exposed to air. pO_2 = 152 mm.	288	$1·1 \times 10^{-3}$	3200
Reduced in pure hydrogen at 350°	501,000	$6·8 \times 10^{-6}$	8300
Exposed to cylinder hydrogen, pO_2 = 0·76 mm.	1,100	$2·9 \times 10^{-3}$	5100
Exposed to poor vacuum, pO_2 < 0·1 mm.	13,600	$2·4 \times 10^{-4}$	5500
Treated with hydrogen sulphide at 300°	288	$1·1 \times 10^{-3}$	3200

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March 18.

MERIAL C. CLARK.
J. S. ANDERSON.

[1] Wilson, *Proc. Roy. Soc.*, A, **133**, 458 (1931); **134**, 277 (1932).
[2] Tubandt and Haedicke, *Z. anorg. allg. Chem.*, **169**, 297 (1927).
[3] cf. Mott and Gurney, "Electronic Processes in Ionic Crystals", p. 167 (Clarendon Press, 1940).

Reaction between Long-Chain Cation-active Salts and Sodium Hexametaphosphate

DURING an investigation involving the use of cation-active salts such as cetyl pyridinium bromide in conjunction with sodium hexametaphosphate, it was observed that precipitates frequently occurred. Further observations on distilled water solutions showed that cation-active long-chain salts of this class give rise to intense turbidity and in some instances to complete precipitation when treated with sodium hexametaphosphate ("Calgon").

The nature of the insoluble complex is not known, but other phosphates such as Na_3PO_4, Na_2HPO_4 and NaH_2PO_4 are without effect. Tetra sodium pyrophosphate gives a slight turbidity.

The literature appears to contain no record of such a reaction, and it is therefore mentioned because of its possible importance in connexion with textile processes where such auxiliaries are sometimes used. It may also have some value in relation to the more academic aspects of the sequestering power of sodium hexametaphosphate.

I am indebted to the Director of Research for his guidance, and to the council of the British Launderers' Research Association for permission to publish this note.

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June 17.

The Donnan Membrane Equilibrium

WHEN applying the distribution law of Boltzmann to the Donnan membrane equilibrium in two compartments, one containing a mixture of colloidal ions (or non-diffusible ions) and electrolytic solutions and the other electrolytic solutions, we have to assume the compartment containing the colloid or non-diffusible ions to consist of a charged material and a double layer, which extends up to the membrane through which the colloidal particles or non-diffusible ions cannot pass. In the case of colloidal solutions, the membrane may also be considered as a plane, separating the double layer and the bulk of the solution through which the colloidal particles cannot pass. The membrane potential, E_m, might be put equal to $\psi_1 - \psi_2$, where ψ_1 is the potential of the ion positive or negative in compartment 1, containing the colloid or the non-diffusible ion, and ψ_2 is the potential of the same ion in the other compartment 2.

We have, therefore, at all values of the membrane potential,

$$q_+(c_+)_1 + q_-(c_-)_1 = \{q_+(c_+)_2 + q_-(c_-)_2\} \cosh \frac{N^* E_m F}{RT} \quad (1)$$

or $$(c_+)_1 = (c_+)_2 \cosh \frac{N^* E_m F}{RT};$$

where $(c_+)_1$ and $(c_-)_1$ are the concentrations of positive and negative ions in compartment 1, and $(c_+)_2$, $(c_-)_2$ the corresponding concentrations of ions in compartment 2;

c_+ is $\dfrac{q_+(c_+) + q_-(c_-)}{q_+ + q_-}$

or $\{(q_+ c_+)^{q_+} (q_- c_-)^{q_-}\}^{1/(q_+ + q_-)}$

and q_+, q_- are the numbers of positive and negative ions; and F is one faraday of electricity, R the gas constant, T the temperature, and $N^* = N_1 = N_2$ or $(N_1 N_2)^{1/2}$.

When $\dfrac{N^* E_m F}{RT}$ is much less than unity,

$$q_+(c_+)_1 + q_-(c_-)_1 = q_+(c_+)_2 + q_-(c_-)_2 \quad . \quad (2)$$

and $$\left(\frac{N^* E_m F}{RT}\right)^4 \ll \left(\frac{N^* E_m F}{RT}\right)^2$$

$$q_+(c_+)_1 + q_-(c_-)_1 = \{q_+(c_+)_2 + q_-(c_-)_2\} \left\{1 + \tfrac{1}{2}\left(\frac{N^* E_m F}{RT}\right)^2\right\} \quad (3)$$

The membrane potential is small when calculated from mean concentrations of ions, and the equation

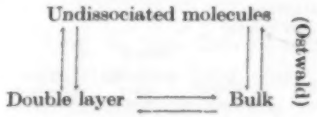
$$(c_\pm)_1 = (c_\pm)_2 \quad . \quad . \quad . \quad . \quad (4)$$

can be deduced from equation (1).

The data of Rinde[1] on sulphur sols, of Azume and Kameyama[2] on congo red and Mattson[3] on bentonite systems show that the relations (1), (2) and (3) hold with accuracy. The relation (4) holds with much greater accuracy.

In considering the equilibrium between ions and

undissociated molecules in solutions of weak electrolytes, the solution may be assumed to consist of two compartments in one of which there are undissociated molecules and ions, and in the other only ions. The uncharged solute species cannot pass into the double layer (ionic atmosphere) and therefore the principle of Donnan membrane equilibrium is applicable. From the equilibrium



we have

$$K = \frac{(c_{\pm})^2 D}{c(1-\alpha)}$$

between the undissociated molecules and the double layer, where K is the equilibrium constant, and c the concentration of the electrolyte with conductivity coefficient α and $(c_{\pm})_D$ is the mean concentration of ions in the double layer. The concentration of ions in the double layer may be found from the distribution law of Boltzmann and

$$K = \frac{c\alpha^2}{1-\alpha} \cosh^2 \frac{N^* E_m F}{RT} \quad . \quad . \quad . \quad . \quad (5)$$

$$= \frac{c\alpha^2}{1-\alpha} \text{ when } \left(\frac{N^* E_m F}{RT}\right)^2 \ll 1,$$

which is Ostwald's dilution law. Equation 5 is the new dilution law from which Ostwald's dilution law can be deduced.

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[1] *Phil. Mag.* (57), **1**, 32 (1926).
[2] *Phil. Mag.*, **50**, 1264 (1925).
[3] *Soil Sci.*, **28**, 179 (1929).

Relation of Tea 'Fermentation' to Normal Respiration

In a recent communication, Sreerangachar[1] has criticized certain of my conclusions as to the relationship existing between the process known as tea-fermentation and the normal respiratory mechanism of the tea-leaf. In view of the somewhat divergent conclusions drawn by this author and myself[2], some further discussion of the results is desirable. Unfortunately such criticisms as are made cannot be backed up by further experiment until we are able to return to our normal peace-time activities.

The fundamental criticism made by Sreerangachar is that neither mechanical rolling nor fine mincing is sufficient to result in the disruption of every cell in the tissue, so that the fermenting leaf must be considered as a heterogeneous mixture of damaged and undamaged tissue. The implication is that in such crushed tissue some respiratory activity will persist.

Sreerangachar then goes on to describe experiments which show that finely minced tea-leaf, as obtained in his laboratory, is in fact a heterogeneous mixture of respiring and 'fermenting' tissue, and that further damage increases the $-Q_{O_2}$ and still further depresses the *R.Q.* He also succeeds in achieving some separation of the fermentation and respiration processes by washing the minced tissue with water. The washed tissue shows practically no fermentation, and as the carbon dioxide outputs of washed and unwashed tissue are not dissimilar he concludes that the carbon dioxide output in the minced tissue is largely contributed by undamaged cells.

This conclusion neglects the possibility that free polyphenols, or their oxidation products, may depress normal respiration and hence carbon dioxide outputs. In finely chopped tissue the carbon dioxide may then originate partially through carbohydrate oxidation with *o*-quinones as the hydrogen-acceptors, and partly as a result of inhibited normal respiration. It is by no means unlikely that the carbon dioxide produced by these two mechanisms will differ but little from that produced by uninhibited respiration in the intact portions of the tissue in the washed material.

Sreerangachar's experiments in which glucose is added, without effect, to an *in vitro* enzyme-substrate mixture have no bearing on the problem, as an enzyme obtained by the action of acetone on tea-leaf tissue would certainly lack many of the factors required to bring about oxidation of glucose by *o*-quinones.

Although it is admitted that Sreerangachar has demonstrated that his minced tissue preparations contain some undamaged tissue in which normal respiration persists, his claim that carbon dioxide evolved from crushed tissue comes only from undamaged cells is by no means firmly established. As shown above, an alternative explanation of these results can be advanced. In addition it may be pointed out that his own figures show, like my own, a rapid drop in carbon dioxide output after the first forty-five minutes. If carbon dioxide were a product solely of respiration one would expect the output to be maintained at or near its original level. A period of constant output followed by a rapid fall to an almost zero level is difficult to explain on Sreerangachar's hypothesis.

It has never been my belief that fermentation takes place only in completely ruptured cells. Damage such as is inflicted during mechanical rolling in manufacture is insufficient to destroy the cellular nature of the tissue, yet fermentation may take place to the extent of 95 per cent oxidation of the polyphenols present. As rolling in the factory is so efficient it follows that the extensive damage involved in grinding the tissue is not necessary for complete fermentation.

It has been my contention that the mechanical damage required to bring about complete oxidation of the polyphenols in the tea-leaf is sufficient to suppress the greater part of normal respiratory activity, and that carbon dioxide produced in fermentation is due to a secondary oxidation of carbohydrates with the *o*-quinones as one of the necessary H-acceptors. The most important items of evidence supporting this view are summarized below.

(1) The fall in carbon dioxide output when oxidation of polyphenols is nearly complete.

(2) The negligible oxygen uptakes and carbon dioxide outputs recorded for non-tanniferous tissue when subjected to the same degree of mechanical damage[3].

(3) The suppression of anaerobic fermentation in tea-leaf tissue sufficiently damaged to undergo complete oxidation of its polyphenols[4].

(4) The stimulation of both oxygen uptake and

carbon dioxide output when fresh polyphenol is added to completely fermented tea-leaf suspensions. This observation cannot be explained by Sreerangachar's hypothesis, but this effect is to be expected if carbohydrate oxidation depends upon the presence of *o*-quinones.

It is considered that the damage brought about either in the factory-treated leaf or in finely minced tissue is sufficient to suppress respiration almost completely, and that the carbon dioxide produced during fermentation is not a product of normal respiration.

Sreerangachar's results become completely intelligible if his mincing process is considered to produce less damage to the leaf than ours. In the Tocklai experiments an attachment used for grinding nuts to a fine paste was employed for the mincing of the leaf. This would be expected to produce a much greater extent of damage than a fine cutter, as in addition to chopping up the tissue it also gives it a considerable shear. It has been emphasized in my recent publications[5,6] that such shearing forces are to be considered as responsible for the disorganization of respiratory processes which results in tea-fermentation.

The effects of a fine chop, such as presumably was obtained in Sreerangachar's laboratory, have been studied at Tocklai. Such a mince gives a rather lower $-Q_{O_2}$, a certain amount of undamaged tissue which remains unfermented, and a comparatively high rate of anaerobic fermentation. There is therefore good reason to believe that Sreerangachar's results are due to a failure to repeat the conditions under which the Tocklai experiments were carried out. In addition it must be emphasized that Sreerangachar's views do not give an adequate explanation of the dependence of carbon dioxide output on polyphenol oxidation. The criticisms made by Sreerangachar are not therefore considered to weaken the theory of tea-fermentation advanced by the author to any appreciable extent.

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Indian Tea Association,
Tocklai Experimental Station,
Cinnamara,
Assam.
April 2.

[1] Sreerangachar, H. B., *Biochem. J.*, **35**, 1106 (1941).
[2] Roberts, E. A. H., *Biochem. J.*, **35**, 1209 (1941).
[3] Roberts, E. A. H., and Sarma, S. N., *Biochem. J.*, **34**, 1517 (1940).
[4] Deb, S. B., and Roberts, E. A. H., *Biochem. J.*, **34**, 1507 (1940).
[5] Roberts, E. A. H., NATURE, **148**, 285 (1941).
[6] Roberts, E. A. H., *Enzym.*, **2**, 113 (1942).

Ascorbic Acid Content of Recently Harvested Cereals and Legumes

IN the course of an investigation, it had become necessary to start some guinea pig growth experiments for assay of ascorbic acid biologically. It was soon found that the animals kept on a scorbutic diet of casein, ground roasted Bengal gram (*Cicer arietinum*), ground oats, cod liver oil and salts did not cease to grow and show depletion even after three weeks. This unusual behaviour was ultimately traced to the ascorbic acid of the cereals and legumes in the diet. These grains were apparently harvested in March–April, and the experiment with the diet containing them started in May. The ascorbic acid contents of the cereals and pulses were estimated by titration with 2 : 6-dichlorophenol indophenol and are given in Table 1.

Table 1.

Material	Ascorbic acid content (mgm./gm.)
Bengal gram (ground and roasted) ..	10·31
Oatmeal (whole)	13·97
Wheat flour (whole)	5·30

Table 2.

No. of animals	Av. weight at start	Av. weight after 3 weeks	Mean growth for the period	Mean weekly growth
8	126 gm.	168 gm.	42 gm.	14 gm.

The ascorbic acid values found by titration have been substantiated by biological assay. Young growing guinea pigs were kept on the diet of casein, ground and roasted Bengal gram, oatmeal, cod liver oil and salts; when the total consumption of food by each animal corresponded to an average intake of about 1 mgm. ascorbic acid per animal per day, they showed a growth response of 14 gm. (mean growth-rate) per animal per week over a three-week test period (Table 2).

I have not seen any similar reference in the literature on the ascorbic acid content of dry cereals and legumes, so far.

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June 3.

High-angle Edge-flaking of Flint

SOME four years ago I carried out a number of experiments in the removal of high-angle flakes from the edges of flints, and feel that examples of the results of this work should now be made public. It will be seen, from the accompanying table, that the angles at which the flakes were removed range from 100° to 140°. The greatest length, and the greatest width, of the flakes removed are also given:

Angle of detachment of flake	Greatest length of detached flake	Greatest width of detached flake
100°	2 in.	1 1/8 in.
102°	1 1/2 in.	1 1/2 in.
105°	1 5/8 in.	1 1/4 in.
110°	1 1/2 in.	1 3/8 in.
132°	1 7/8 in.	1/4 in.
140°	1 3/8 in.	1/2 in.

The detachment of these high-angle flakes from the edges of large nodules of flint was accomplished by the use of a weighty hammer-stone of quartzite. No other method of detachment was adopted. In one case the removal of a consecutive series of these flakes from the edge of a flint was accomplished. These flakes were detached at angles of 102°, 105° and 110° respectively. The angles enumerated in this note are those formed between the striking-platform and the flake-scar upon the parent block. It seems probable that further practice in this work may result in the removal of high-angle edge-flaking from flints with comparative ease and precision.

I have placed a typical series of the experimental specimens on exhibition in Ipswich Museum.

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Flatford,
East Bergholt,
Suffolk.

A Nuclear Ring in the Developing Male Germ Cells of the Dog and Cat

I REGARD Mr. Zlotnik's[1] nuclear ring in the dog spermatid as an Aoyama picture of the same post-nuclear granules drawn in Fig. 3, plate 28 of my 1929 paper[2]. The Da Fano and Cajal pictures also differ slightly in the exact amount of silvering and in the substrate in which the silver comes to rest. As mentioned in a previous communication[3], the dog spermatogenesis is in some ways clearer to study and interpret, and in it Mr. Collery and I have been able to follow the granules of the middle piece bead rudiment right back to the early spermatocyte. As regards the human post-nuclear body, Dr. Beams and I[4] had no silver material to study. Probably osmium tetroxide impregnates the bottom of the band first, and not the top as does silver. However, Mr. Collery has recently made me some excellent slides of human material by the Aoyama technique, and I hope to study the method of formation of the post-nuclear band in the near future. Mr. Collery and I have been unable to agree with Bell's[5] account of the origin of fat from broken-down Golgi remnants in the dog. We believe the fat appears by unmasking of droplets in the peeling-off cytoplasm. I note that Mr. Zlotnik figures the neck or middle piece bead in some of his drawings. At the present moment I believe my previous account of its origin from an argentophile structure in the spermatid to be correct; but I do not think that this structure buds off from the Golgi apparatus after acrosome formation, for the reason given above. Mr. Collery and I are still working on the origin and fate of the two argentophile beads (inner and outer) associated with the middle piece of the mammalian spermatozoon, and both of which can be found in spermatids.

I am glad that Mr. Zlotnik has been able to confirm the presence of the post-nuclear body, which I have shown to be present in the spermatozoa of various animals. There is just one point in technique which I should mention: in recent work I have noted that Mr. Collery's preparations made by the Aoyama method, cut by the freezing microtome and mounted in glycerine jelly, are superior to anything I had to study in 1929. Perhaps Mr. Zlotnik already knows the valuable papers by Popa and Marza[6] which I have found very interesting, and which are not so well known as they should be.

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June 17.

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Science, Christianity and Truth

Two passages in the Rev. Hardwick's review of Canon Baker's "Science, Christianity and Truth"[1] call for comment.

He writes: "Canon Baker's words are only too true: 'The scientists, because they can say nothing more of man than that he is the product of evolution, here to-day and gone to-morrow, have no reply to the Nazi or Fascist or Communist assumption that liberty is only a fad or a prejudice and the individual is nothing compared with the Race or State or Working Class'."

This appears to me so extraordinary a statement, especially in the columns of NATURE, that I at first thought I must have misread it. It runs counter to modern trends in evolutionary theory[2] and in sociology[3]. In point of fact, the precise opposite is probably true, namely, that evolution (under which social as well as organic evolution is, of course, to be included) provides the only external yardstick or standard by which to measure the correctness of our social principles and our ethical judgments. This has been pointed out, for example, by Waddington[4], and later in more detail by myself[5].

Secondly, the Rev. Hardwick quotes his author, apparently with full approval, as follows: "In his remarkable chapter, 'Is there a God?', Canon Baker writes: 'If there be no other ground and cause of existence than the irrational, the meaningless, the unconscious, the blind, then there is no reason to believe that our reasoning arrives at truth rather than error. . . .' Here again we have an idea which the scholastics would have grasped at once, namely, that the existence of God is pre-supposed in all our thinking, whether we realize it or not".

Whether men of science realize this or not, the great majority of them would, I imagine, agree that their criterion of "arriving at truth rather than error" lies in correspondence with fact, and is therefore provided by the scientific method of submitting their conclusions to independent verification, and refusing to accept any conclusions which are not capable of such verification, rather than in any deductions from the "ground and cause of existence" (whatever that may imply: personally I find it difficult to attach any meaning to the idea of a cause of existence).

I direct attention to these points because there is at the present time in various quarters a marked tendency to reject the scientific point of view and to revert to a pre-scientific attitude. In particular, "Science" is accused of materialism, and its relevance to social principles and to philosophical problems is called in question. Accordingly it is of some importance for men of science to think out in the fullest possible way the implications of their subject and its method, notably perhaps in fields where values are concerned, the better to resist these attempts to restrict the scope of science and its applications.

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June 30.

[1] NATURE, **151**, 710 (1943).
[2] See, for example, the last two essays in J. Needham's "Time: the Refreshing River"; London (1943).
[3] For a general discussion, based on the scientific approach, of desirable social trends, see the articles signed "Archimedes" in *Horizon* of July 1942 and subsequent issues.
[4] "Science and Ethics", NATURE, **148**, 270 (1941). Later reprinted with contributions from numerous other writers in book form: "Science and Ethics"; London (1942).
[5] "Evolutionary Ethics" (Romanes Lecture, Oxford, 1943; in the press).

Future of Technical Colleges

IN recent educational discussions changes have been suggested in the relative status of university and technical institutions. Some of the suggestions have taken form and substance in various reports, for example that of the Institute of Physics dealing with the education and training of physicists. The policies suggested have so fundamental a bearing on the future of technical colleges of the first rank that they should be made as public as possible before any irreparably damaging step is taken. One notes, for example, that the report referred to hopes to "relieve the Technical Colleges of the necessity of preparing students for External University Degrees". The elastic term technical college includes institutions of every type from the lowest to the highest rank, and the subsequent discussion and suggestions refer to those technical colleges of the highest rank, which would suffer most greatly by this step. Such a "relief" would, in the opinion of a large number of those interested in the growth of technical education, disable and de-rank big technical institutions which have rendered sterling service to technology, and have striven hard, often with little national or local interest, to become institutes of technology of university rank and status.

Whatever policies in technical education the post-war period ushers in, the standard of highest rank technical colleges, with their fine record of service and close attention to the needs of industry, should be safeguarded more than ever in a world where technology seems destined to play an ever-increasing part. Even major technical colleges have suffered too much in the past from being maintained as subordinate institutions. From this position, the only means of escape has been to become university colleges, and in the process of transition many purely technical departments have become attached to universities, the functions of which are more normally academic. This process of accretion of technical departments to universities could not but be accelerated by the move suggested by the Committee, denying as it does the right of the technical college to give the highest training to the young technologist. The best general training which can be devised is along the lines of a university degree course in technical subjects, such as chemistry, physics, engineering, pharmacy, commerce, chemical engineering, metallurgy, textile technology and the like, and no such crippling handicap should be imposed on big technical colleges and their students as denying the former the right to their proper function, and the latter their right to the highest standard of tuition there.

In our opinion, the correct development of technical education does not lie along lines of transference of all higher flights of technology to the universities. Instead there should be in Great Britain a group of institutes of technology, properly equipped and adequately financed, of definite equality in status to the universities. Such institutions exist in the Continent of Europe and in the United States. No one there, even from the universities, would think of de-ranking them. They send out a flow of graduates who take the highest industrial posts; they contribute a steady stream of fundamental research; their professors are world-famous. The lustre of the Zurich Polytechnic, or the Massachusetts Institute of Technology, to name two of many equally splendid institutions, is as bright as that of any contemporary university. It is difficult, with the totally different example and experience of so many other countries before one, to contemplate such a retrograde step as that recommended by the Report, which leaves the technical colleges, irrespective of their standing, only minor courses of National Certificate character, and only second-rate students.

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Microchemical Apparatus

The microchemical apparatus used in Great Britain before 1939 was, in the main, imported from Austria, where Prof. Pregl and his co-workers instructed competent apparatus makers such as Paul Haack, and approved for use in the exacting microchemical technique the products they manufactured.

Chemists in Great Britain have been slow to adopt micro methods. We believe this to be due to a number of causes. (*a*) The lack of an active organization to arrange meetings and demonstrations and to develop an interest in the subject. The Microchemical Club did something towards this end, but it is now defunct[1]. (*b*) The foreign apparatus was imported and could not, therefore, be described as being 'freely' available. The spread of a new science is greatly encouraged if the apparatus for it is easy to obtain. (*c*) Arising out of (*a*) and (*b*), the diversity of views among workers and their failure to agree how microchemical apparatus should be constructed. It is true that text-books describe minutely some of the special points to be observed during manufacture; but many features are not clearly specified, either by illustration or by literary description. Glassblowing is an art; not a precise engineering operation; tolerances have to be allowed and the closer the tolerances the greater the difficulty in manufacture and hence the greater the cost.

Until, therefore, microchemists can band themselves together for their common interest and agree what they want and how it should be made, dissatisfaction with British-made apparatus will continue to be expressed by some of them. In the United States a start has been made and some approved specifications have already been published[2].

In our view the bodies in Great Britain primarily interested should appoint a panel to draw up specifications acceptable to both users and manufacturers. These might be the British Standards Institution, the Society of Public Analysts and Other Analytical Chemists, the Chemical Society, the Royal Institute of Chemistry, various Government Departments and others concerned, and work here should be linked up with what is being done in the United States.

British manufacturers are ready and willing to give their full co-operation in any project for the standardization of apparatus for this growing science. This Association would welcome collaboration with any microchemical organization in the examination, from the manufacturing point of view, of any draft specifications.

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MAGNESIUM-CALCIUM ANTAGONISM IN MUSCLE

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IN skeletal muscle, the energy needed for the contraction is probably provided by the hydrolysis of adenosinetriphosphate. Adenosinetriphosphatase, the enzyme which catalyses this reaction, is intimately associated with myosin, the contractile protein itself[1]. There is evidence from experiments *in vitro* that elongated myosin molecules contract as the adenosinetriphosphate breaks down[2]. In the resting muscle fibre, the adenosine compounds are spatially separated from the myosin, the former being in the isotropic and the latter in the anisotropic segments; during activity the adenosine compounds migrate into the segments containing the myosin[3]. The adenosinetriphosphatase of myosin is activated by calcium ion[4,5]. Ljubimova and Pevsner[6] have reported some inhibition (*ca.* 30 per cent) by Mg^{++}. During a study[7] of the enzymes of human tissues, however, we prepared human myosin and found that Mg^{++} powerfully suppresses the Ca^{++} activity. With very dilute rabbit myosin, where addition of Ca^{++} is essential, the activity in presence of 2×10^{-3} *M*.$CaCl_2$ was reduced by 82 per cent when as little as $2{\cdot}5 \times 10^{-4}$*M*.$MgCl_2$ was present (Fig. 1).

Mg^{++} thus overcomes the activation of adenosinetriphosphatase by Ca^{++}; but to determine whether this is a result of competitive inhibition, it had to be ascertained whether the inhibition by Mg^{++} decreases when the Ca^{++} concentration is raised above a value already causing maximal activation. A difficulty arose here because there is only a narrow range of Ca^{++} concentrations over which the activation is maximal, since the activity falls off at higher Ca^{++} levels (Fig. 1). However, it was the same with 2×10^{-3}*M*.Ca^{++} as with 4×10^{-3}*M*., whereas the same Mg^{++} concentration was less inhibitory at the higher of these two Ca^{++} levels. This is strong evidence for a competitive inhibition of Ca^{++} activation by Mg^{++}.

It occurred to us at once that this antagonism might be of significance in the so-called 'magnesium

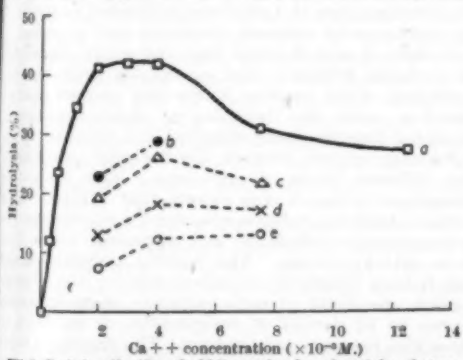

Fig. 1. Ca++ activation of rabbit myosin adenosinetriphosphatase; competitive inhibition by Mg++. 150 sec. at 37°. 0·05*M*. glycine buffer *p*H 9·2. Per ml. reaction mixture: 0·0054 mgm. protein -N, 0·069 mgm. adenosinetriphosphate (as '7 min. P_2O_4'). Total vol. 4 ml. Concentration of $MgCl_2$ (*M*. × 10^{-3}): *a*, 0; *b*, 3; *c*, 6; *d*, 12·5; *e*, 25 (Hilger Absorptiometer used in phosphate determinations).

"Hydrolysis (%)" in Figs. 1 and 2 refers to one phosphate group, since 100% hydrolysis by myosin releases only one of the three phosphate groups of adenosinetriphosphate.

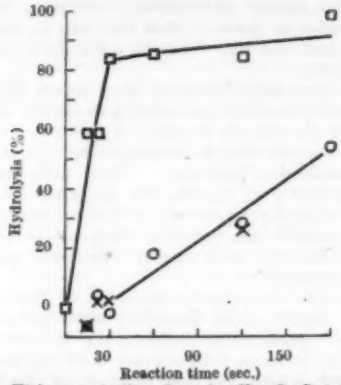

Fig. 2. High concentration of myosin, *p*H *ca.* 7; Ca++ activation and its inhibition by Mg++. 37°. Per ml. reaction mixture: 1·2 mgm. protein -N, 0·305 mgm. adenosinetriphosphate (as '7 min. P_2O_4'). Total vol. 1 ml. ○, no addition; □, 0·01 *M*.$CaCl_2$; ×, 0·01 *M*.$CaCl_2$ + 0·01 *M*.$MgCl_2$.

narcosis'[8], which is of clinical interest since $MgSO_4$ has been injected in combination with general and spinal anæsthetics, and is used in psychiatry to 'soften' the convulsions of metrazol therapy. The 'narcosis' consists primarily of a paralysis, of peripheral origin, of the skeletal musculature, which passes off immediately on the injection of $CaCl_2$. It is thus an outstanding example of Ca-Mg antagonism *in vivo*; but before discussing whether our observations can elucidate any *in vivo* phenomena, two possible objections must be considered.

First, as is usual with myosin, the above experiments were carried out at the unphysiological *p*H of 9·2. We have found, however, that Mg^{++} still overcomes Ca^{++} activation at *p*H *ca.* 7, both in presence of glycine buffer, and also (Fig. 2) when the sole buffering is provided by the myosin and adenosinetriphosphate.

Secondly, high concentrations of myosin show adenosinetriphosphatase activity in the absence of added Ca^{++}, even with repeatedly washed protein[5]. We have found that it is much less affected by Mg^{++} than is the catalysis activated by *added* Ca^{++}; as much as 0·04 *M*.$MgCl_2$ reduces it only by 35 per cent. It might therefore be objected that in muscle, where the myosin is highly concentrated, the adenosinetriphosphatase activity should be insensitive to Mg^{++}. However, using myosin in fairly high concentrations, and measuring the activity over short time-periods (Fig. 2), we found that after thirty seconds the reaction in presence of calcium was almost complete, whereas in absence of Ca^{++} the conversion was negligible. Furthermore, addition of Mg^{++} had completely suppressed the activity induced by Ca^{++}.

Hence if muscle twitches, which are of very short duration, fail to appear under the influence of Mg^{++}, the enzymological evidence permits the explanation that the effect is due to inhibition of the myosin adenosinetriphosphatase. In the *frog*, this is probably the case in the later stages of the narcosis, since after injection of $MgSO_4$ into the dorsal lymph-sac the leg muscles ultimately fail to respond to direct electrical stimulation[9]. Further, when denervated frog muscle, and also single fibres, are transferred from Ringer solution to isotonic $MgCl_2$ solution, the threshold of response to electrical stimulation is raised[10].

In the *mammal*, however, present knowledge of the

muscular relaxation immediately following $MgSO_4$ injection makes it unlikely that this can be ascribed to a direct action of Mg^{++} on the contractile protein, for two reasons:

(1) It is generally realized that when Mg^{++} is injected and produces muscular relaxation, it does not paralyse the muscle directly. It acts in a similar manner to curare, which interrupts transmission at the neuromuscular junction. Thus following the injection of Mg^{++} or curare, the response to direct stimulation remains when that to indirect stimulation has disappeared[11], the latter is temporarily restored after tetanization[12], and similar chronaxie relationships are observed[13].

(2) After the intravenous injection of $MgSO_4$ into dogs, the Mg^{++} most probably distributes itself through the extracellular fluid of the body[14] and is thus unlikely to come into contact with myosin.

In a paper which has just reached us, DuBois *et al.*[15] put forward as an explanation for magnesium narcosis the mechanism which we have been considering, namely, that Mg^{++} competes with Ca^{++} and prevents the breakdown of adenosinetriphosphate. This hypothesis must be rejected for the reasons given above. The increased adenosinetriphosphate content of the muscles of animals under magnesium narcosis, which is the sole evidence adduced by the American authors, might well be due to the relaxation; it remains to be shown that curare would not give the same effect.

Furthermore, the antagonism between Ca^{++} and Mg^{++} is not unique for myosin. The adenosinetriphosphatase activity of the electric organ of Torpedo[16], which is not due to myosin, is activated by Mg^{++}[17]. We have found that here Ca^{++} is inhibitory.

Electric organ extracted with 1·5 vol. of water. In each tube, 0·4 ml. extract, 1 ml. glycine buffer pH 8·2 (37°); 0·42 mgm. adenosinetriphosphate (as '7 min. P_2O_5'), total vol. 2·5 ml. 10 min. at 37°.

	—	$M/250$ $CaCl_2$	$M/250$ $MgCl_2$	$MgCl_2$ + $CaCl_2$
% of 7 min. P_2O_5 hydrolysed	17	6	45	7

It seems probable that this antagonism is widespread, so that when one of these ions is an activator, the other may be expected to be inhibitory. If in neuromuscular transmission some enzyme process is activated by Ca^{++}, and it is noteworthy that a dependence on the Ca^{++} level has been shown[18], Mg^{++} might be expected to suppress it. Thus for magnesium narcosis our observations may serve only as model experiments. There is, however, one phenomenon in the mammal for which they may offer a direct explanation.

Magnesium deprivation tetany in the rat is in some ways the converse of the paralysis following magnesium injection, the hyper-irritability increasing when the calcium level of the diet is raised[19]. Since the threshold of response of the leg muscles to galvanic stimulation of the motor nerve is lowered[19], and curare does not decrease the severity of the convulsions[19], it is possible that the hyper-irritability arises *in* the muscles. Although the mammalian muscle cell is probably impermeable to *injected* Mg^{++} [14], its magnesium content is high[21]. Conceivably a lowering of this level by magnesium deprivation might lead to accelerated adenosinetriphosphate breakdown by myosin, with exaggerated response to motor stimuli and the appearance of tetany.

We are grateful to Dr. R. Ström-Olsen, physician superintendent of Runwell Hospital, for his encouragement; to Drs. D. M. Needham and K. Bailey, of the Biochemical Laboratory, University of Cambridge, and Drs. G. L. Brown and F. C. MacIntosh, of the National Institute for Medical Research, with whom these problems have been discussed.

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RECENT ADVANCES IN IMMUNOCHEMISTRY*

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ALTHOUGH methods for protecting man and animals against certain infectious diseases have been known for many years, it is only within the last decade that the nature of the substances that induce this resistance have been at all clearly defined and their composition and structure expressed in terms of the fundamental sciences, chemistry and physics.

At first it was believed that the strict specificity of bacterial antigens—the substances inducing the formation of the immune bodies that protect against infection with the homologous micro-organism—depended largely on the chemical and physical differences that existed between the bacterial proteins of the different kinds of organisms. This view was abandoned when it was shown that filtrates from virulent bacterial cultures contained a soluble specific polysaccharide substance and appeared to be free from intact protein. The specific polysaccharides which were found to be responsible for the characteristic specificity of each organism were, however, shown to be devoid of antigenicity, or at most to show this property only weakly. The results of these researches on the specific polysaccharide components of the whole bacterial antigen were of the greatest importance because later studies, which developed as a direct result of this work, formed the basis of our present knowledge of antigenic structure.

* Substance of a lecture before the London and South Eastern Counties Section of the Royal Institute of Chemistry on June 16.

Until quite recently no attempt to separate the somatic antigens from the bacterial cell had been successful, but within the last ten years several methods for the isolation of fully active bacterial antigens from Gram negative organisms have been elaborated. The earliest practical method to accomplish this was introduced by Boivin, who extracted bacteria at 0° with 0·2 *N*. trichloracetic acid (*p*H 1·0-2·0). The extract was apparently free from intact protein and was powerfully antigenic. At about the same time and quite independently, Raistrick and Topley found that by the action of trypsin on certain bacteria it was possible to bring the antigenic complex into solution. The digestion was carried out at *p*H 8·2-8·5 for several days at 37°. Methods of isolation that depend on extraction of the bacteria with cold anhydrous organic solvents, such as diethyleneglycol, in which native proteins and many bacterial somatic substances are insoluble, have also been successfully employed to isolate these important biological complexes.

It is certain that as our knowledge of the nature of the bacterial somatic antigens grows, we shall find very different types of chemical structures associated with bacterial and tissue antigenic complexes. We already know, however, that certain groups of bacteria possess antigens that are built up from similar types of molecules arranged together as polymolecular aggregates. As an example of this similarity in structure the *O* somatic antigens of *Bact. typhosum* and *Bact. dysenteriæ* (Shiga) may be mentioned. Each antigen is built up of a polysaccharide, specific for the organism and responsible for its characteristic serological reactions, and a polypeptide-like component (most probably a conjugated protein). Other components of the native antigenic complex, such as phospholipin, also occur, and it is possible that further unidentified substances are present.

In certain instances, however, it has been shown that of all the components present in the native antigenic complex only two, the polysaccharide and protein, are essential for the manifestation of antigenicity. It seems probable, therefore, that a bacterial antigen as it exists in the intact bacterial cell is not a simple compound of rigid chemical composition, but consists of a labile molecular aggregate possessing an essential component—such as a polysaccharide—of definite chemical structure and of fixed composition, which determines the strict specificity of the antigen, together with other loosely bound constituents which endow the essential component with antigenic properties. Only part of these physically associated molecules are necessary for the manifestation of the specific antigenic properties, and certain of these constituents can be dissociated from the labile complex during the isolation and purification of the antigen without producing more than a moderate reduction in the antigenic capacity of the active material. More thorough physical disaggregation of the polymolecular complex into single types of molecules will lead to complete loss of the original antigenicity that gives rise to the homologous immune body.

Considerable support for this conception of antigenic structure was obtained when it was observed that the isolated and undegraded specific polysaccharide component of the antigen could be re-combined with the conjugated protein component, under almost physiological conditions, to form an antigenic complex that would give rise to antibodies specific for the polysaccharide component of the newly formed complex. Neither component showed any specific antigenic properties when tested alone. Furthermore, it has been found that the non-antigenic, specific polysaccharide of one organism will form an antigenic complex when combined with the conjugated protein component derived from the corresponding somatic antigen of another organism that belongs to an entirely different bacterial species. The nature of the bonds that hold the different types of molecules together as a polymolecular aggregate is unknown. Future work will certainly decide whether the association of the various component molecules is due to 'salt-like linkages', hydrogen bonds, van der Waals' forces or to some as yet unknown mechanism. It can only be stated at the present time that the forces concerned give rise to an aggregate with sufficient stability to make it behave as an independent molecular species.

Further evidence in support of these ideas on antigenic structure is derived from the success with which certain non-antigenic polysaccharides of both vegetable and animal origin have been converted to full antigens by combination with the reactive bacterial conjugated protein mentioned above. The artificial antigens again give rise to immune body that reacts specifically with the polysaccharide component used to build the antigenic complex.

Antibodies against the polysaccharides agar-agar, cherry gum and gum acacia have been described, and more recently immune sera capable of specifically agglutinating human *A* red blood cells but not those of groups *B* and *O* have been prepared by combining a naturally occurring but non-antigenic polysaccharide complex that possesses blood group *A* specificity with a bacterial somatic conjugated protein. It is believed that these powerful anti-*A* sera will be useful in certain blood-group determinations and will prove to be of value in the technique of differential agglutination.

It is clear that bacterial and tissue antigens that are largely polysaccharide in nature belong to a class of substances that are characterized as 'large molecules'. They display unusual properties and it will be necessary to develop new methods for handling them and new chemical conceptions to explain their nature and function.

RADIO RESEARCH ON METRE WAVES

THREE papers by members of the staff of the Radio Department of the National Physical Laboratory appear in the March issue of the *Proceedings of the Wireless Section of the Institution of Electrical Engineers*.

The first paper, on a study of the propagation of ultra-short waves between Guernsey and England, by Dr. R. L. Smith-Rose and Miss A. C. Stickland, was referred to in NATURE of January 2, p. 31.

Following this is a paper by Messrs. F. M. Colebrook and A. C. Gordon-Smith, entitled "The Design of Ultra-Short Wave Field-Strength Measuring Equipment". This comprises a description of the essential features of design and construction of apparatus for measuring field-strength, and suitable for any radio-frequencies between 30 and 600 megacycles per second; that is, wave-lengths between 10 and 0·5 metres. The equipment is of a relatively narrow

band width type (about 20 kc./s.), and is primarily intended for the measurement of continuous-wave fields of the order of tens or hundreds of microvolts per metre. The description is supplementary to a previous paper on the subject which dealt with measurements at wave-lengths down to about 7 metres. For shorter wave-lengths than this, a half-wave-length dipole is the most practicable form of aerial, and this is coupled to the frequency-change unit by a flexible transmission line. For wave-lengths less than about one metre, it is an advantage, from the viewpoint of ease of operation and increase in sensitivity, to use a flat sheet reflector behind the aerial, together with a shorter transmission line. The frequency change unit incorporates a diode, and it is convenient to operate the local oscillator at one half or one third of the signal frequency.

The measurements made with this equipment rest ultimately upon the intermediate-frequency amplifier, which can be calibrated for gain over a wide range. Such calibrated amplifiers have been developed at the National Physical Laboratory, and used extensively for field work: an improved version has been developed for laboratory work, and the more important features of this have been incorporated in a commercial form of the field equipment. In operation at the higher frequencies, it has been found necessary that the complete assembly should be thoroughly screened: the batteries are contained in a separate metal box and connected to the amplifier and frequency-change units by screened flexible leads and screened plugs. The overall calibration of the complete equipment is carried out by the measurement of a known, preferably horizontally polarized, field produced by a radiation method described in a previous publication.

The third paper in the series is by Dr. J. S. McPetrie and J. A. Saxton, and is entitled "The Determination of the Electrical Properties of Soil at a Wave-length of 5 Metres (Frequency 60 Mc./s.)". This gives an account of experiments made to determine the electrical properties of various ground surfaces from the reflexion coefficient obtained for radiation at normal incidence. The experimental technique used a horizontal transmitting aerial set at a height of about 12 m. above the ground; and the stationary wave pattern formed between this aerial and the ground was explored by observing the current induced in a horizontal receiving dipole placed at various heights. The observed results showed good agreement with theoretical curves calculated on the assumption that reflexion takes place actually at the ground surface. The sites investigated varied from wet clay to gravel; the corresponding values of dielectric constant ranged from about 5 to 60, while the values of conductivity varied from less than 10^{9} up to, but not greater than, 10^{9} E.S.U.

The lowest values in each case refer to a site which had been excavated to a depth of seven feet, exposing a surface of pure gravel, with no sign of humus or decayed vegetation. A nearby undisturbed site on the same subsoil, but with about nine inches of grass-covered soil on top, gave a reflexion coefficient similar to that obtained on other grass-covered sites. The above values of the electrical constants obtained with undisturbed soil agree with those measured in the laboratory for samples of similar types of soil. The experiments were made during winter months under rather wet conditions: the values of both dielectric constant and conductivity would probably be less during the summer.

FORTHCOMING EVENTS

Friday, July 16—Monday, July 19

ASSOCIATION OF UNIVERSITY PROFESSORS AND LECTURERS OF THE ALLIED COUNTRIES IN GREAT BRITAIN (at New College, Oxford).

Saturday, July 17

At 9.45 a.m.—Separate Meetings of Sections.
At 2.30 p.m.—Collective Groups of Meetings.

Sunday, July 18

At 10 a.m.—General Meeting.

Monday, July 19

At 10 a.m.—International University Conference of the Associat... of University Teachers.

Wednesday, July 21

INSTITUTE OF FUEL (in the James Watt Memorial Institute, Gre... Charles Street, Birmingham), at 2.30 p.m.—Mr. L. W. Andrew a... Dr. E. A. C. Chamberlain: "Radiant Heat for Industrial Process... 'Infra-red' by Gas".

Friday, July 23

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechani... Engineers, Storey's Gate, Westminster, London, S.W.1), at 5.30 p.... —"The Education and Training of Aeronautical Engineers".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on... before the dates mentioned:

SPEECH THERAPIST (full-time)—The School Medical Officer, To... Hall, Ealing, London, W.5 (July 22).

RESPONSIBLE TEACHER OF ENGINEERING in the Batley Techni... College and School of Art—The Director of Education, Educat... Offices, Batley, Yorks. (July 22).

A POST ON THE CHEMICAL RESEARCH STAFF of the Tin Resea... Institute—The Secretary, Tin Research Institute, Fraser Ro... Greenford, Middx. (July 24).

COMBINED POST OF FULL-TIME (ACTING) RADIOTHERAPIST TO T... LIVERPOOL CANCER CONTROL ORGANIZATION and (ACTING) MEDI... DIRECTOR OF THE RAD... THERAPEUTIC DEPARTMENT OF THE LIVERP... RALIUM INSTITUTE—... Hon. Secretary, Liverpool Cancer Cont... Organization, 66 Rodney Street, Liverpool 1 (July 24).

HEADMASTER OF THE DAY SCHOOL attached to the South-W... Essex Technical College and School of Art, Walthamstow—The C... Education Officer, County Offices, Chelmsford (July 24).

WOMEN PSYCHIATRIC SOCIAL WORKERS at the Birmingham C... Guidance Clinic—The Chief Education Officer, Education Of... Margaret Street, Birmingham 5 (endorsed 'Psychiatric Social Worki... (July 29).

GENERAL MANAGER AND ENGINEER OF THE SHEFFIELD WA... UNDERTAKING—The Town Clerk, Town Hall, Sheffield 1 (July ...

SPEECH THERAPIST (full-time)—The Secretary for Education, Edu... tion Offices, York (August 6).

CHEMIST AND ASSAYER on the establishment of the South Afri... Mint, Pretoria—The Secretary, Office of the High Commissioner ... the Union of South Africa, South Africa House, Trafalgar Squa... London, W.C.2 (August 31).

HEADS OF THE DEPARTMENTS OF PHYSIOLOGY, MEDICINE, ... SURGERY—The Bursar, Royal Veterinary College and Hospital, ... The University, Reading (October 1).

CHAIR OF NAVAL ARCHITECTURE—The Acting Secretary of Univ... sity Court, The University, Glasgow (October 4).

SCIENCE AND MATHEMATICS MASTER at the English High School ... Boys, Istanbul—The British Council, 3 Hanover Street, London, W... (endorsed 'Istanbul').

ANALYST AND ANIMAL NUTRITION ASSISTANT (temporary)—T... Principal, Harper Adams Agricultural College, Newport, Shropsh...

PSYCHIATRIC SOCIAL WORKER—The Medical Superintende... Springfield Mental Hospital, Tooting, London, S.W.17.

TEACHER OF MATHEMATICS AND SCIENCE in the Junior Techni... School (temporary)—The Clerk to the Governors, North-East Es... Technical College and School of Art, Colchester.

ASSISTANT ENGINEER for the Government of Northern Rhode... Public Works Department—Ministry of Labour and National Serv... Central (Technical and Scientific) Register (Reference E.697), Al... andra House, Kingsway, London, W.C.2.

ENGINEER (MECHANICAL) to carry out work of national importa... —The Ministry of Labour and National Service, Central (Techni... and Scientific) Register (Reference No. C.1660), Alexandra Hou... Kingsway, London, W.C.2.

INDUSTRIAL PLANNING OFFICERS (9) (Reference No. C.1771), ... ASSISTANT INDUSTRIAL PLANNING OFFICERS (6) (Reference No. C.17... for the Aeronautical Division of the Department of Supply of ... Government of India—The Ministry of Labour and National Serv... Central (Technical and Scientific) Register (quoting appropri... Reference No.), Alexandra House, Kingsway, London, W.C.2.